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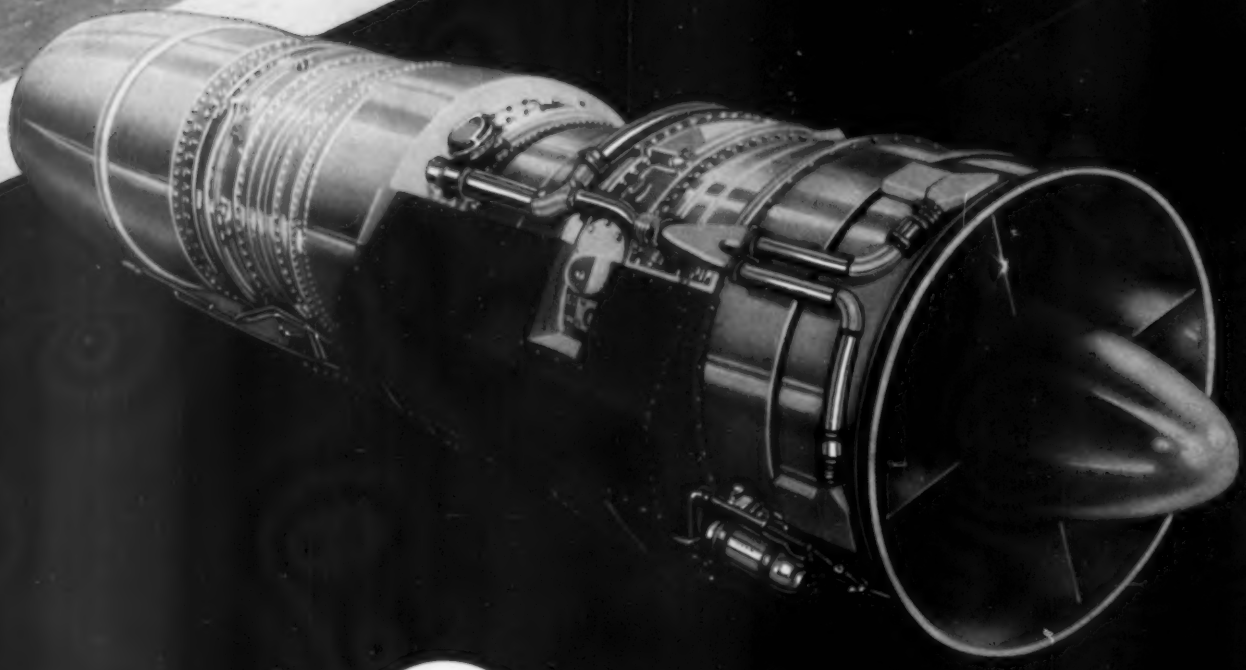

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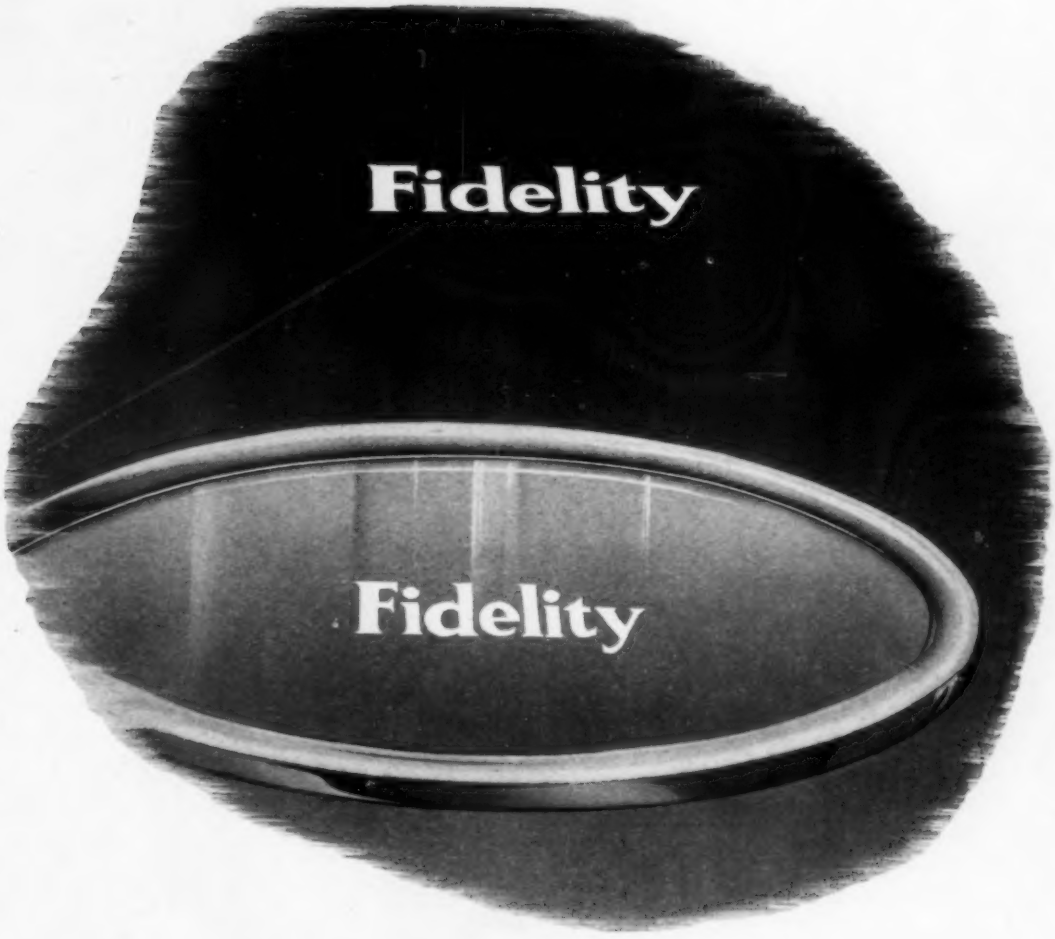

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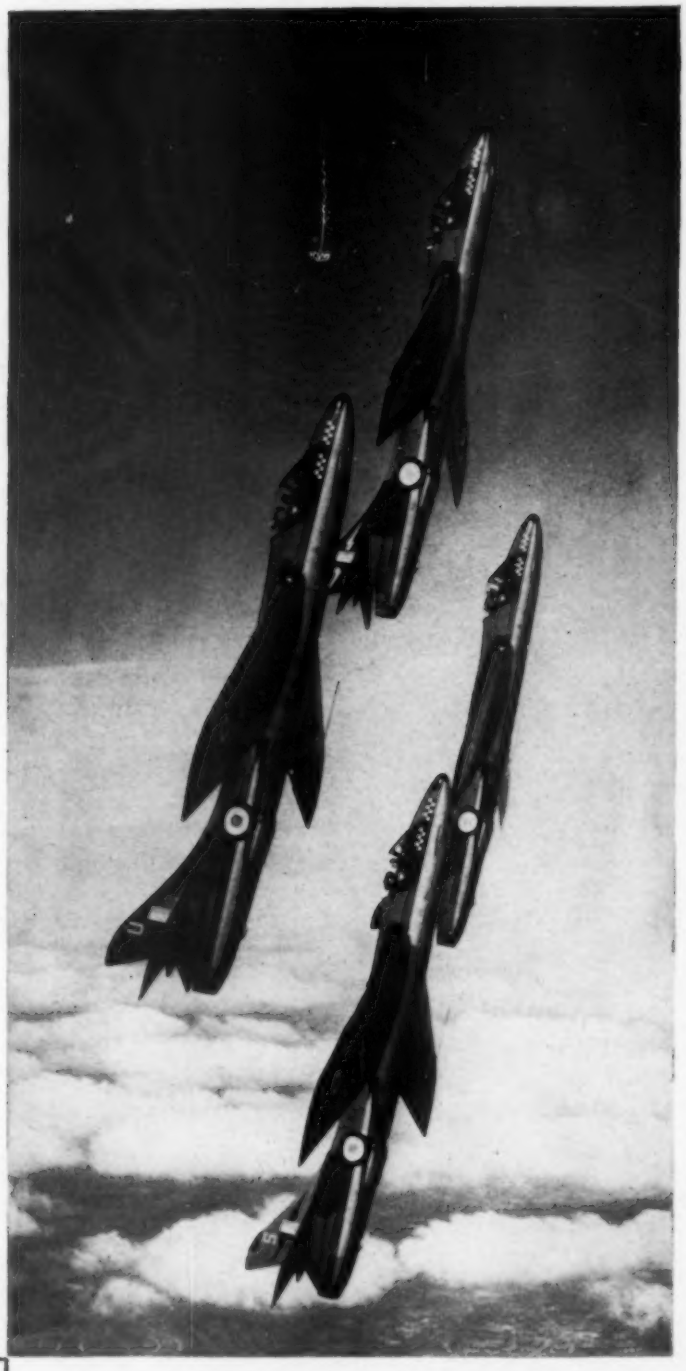

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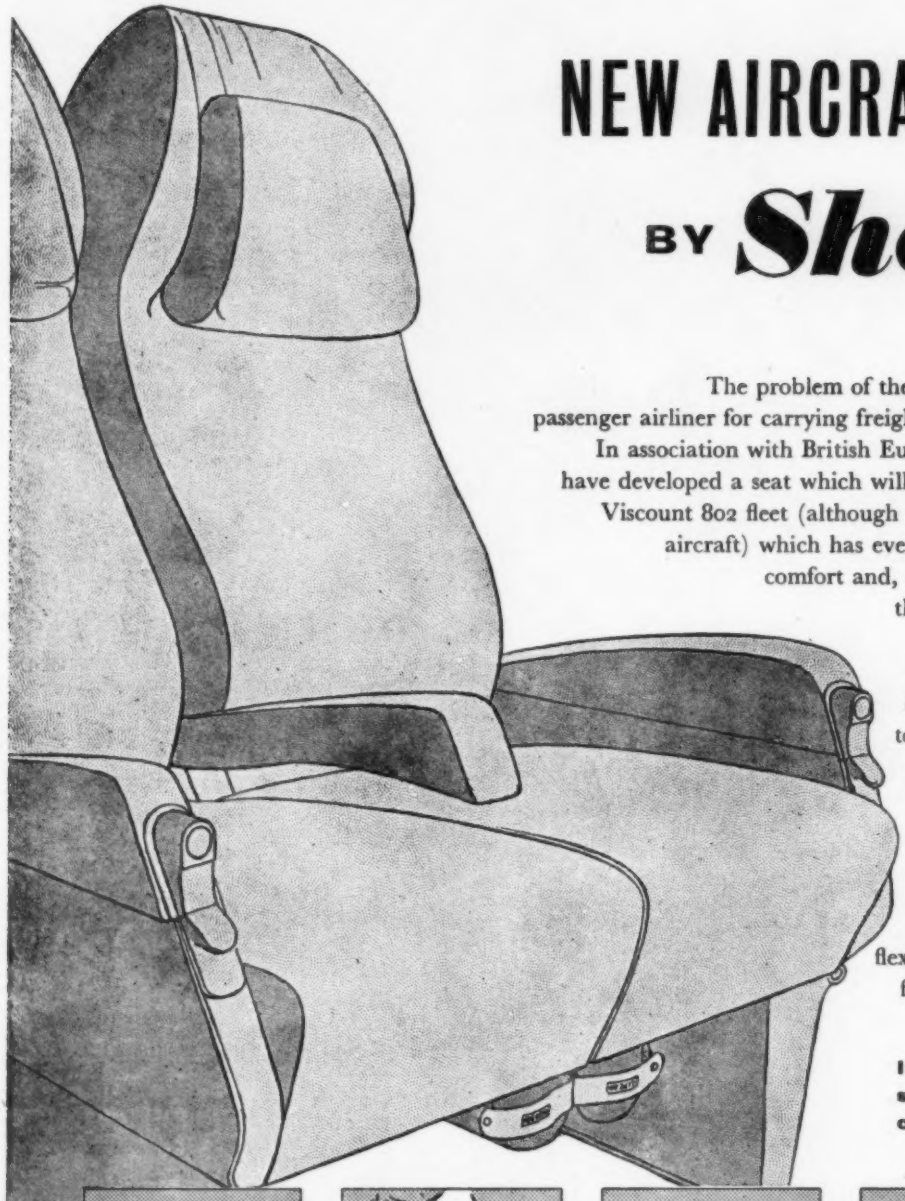

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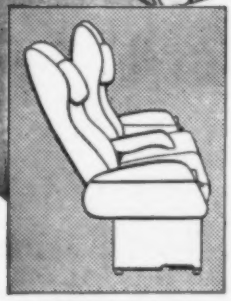

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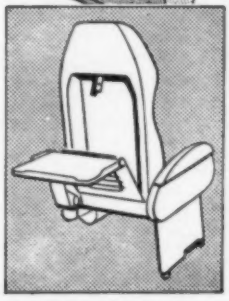

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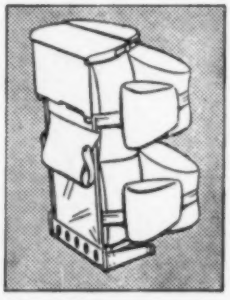

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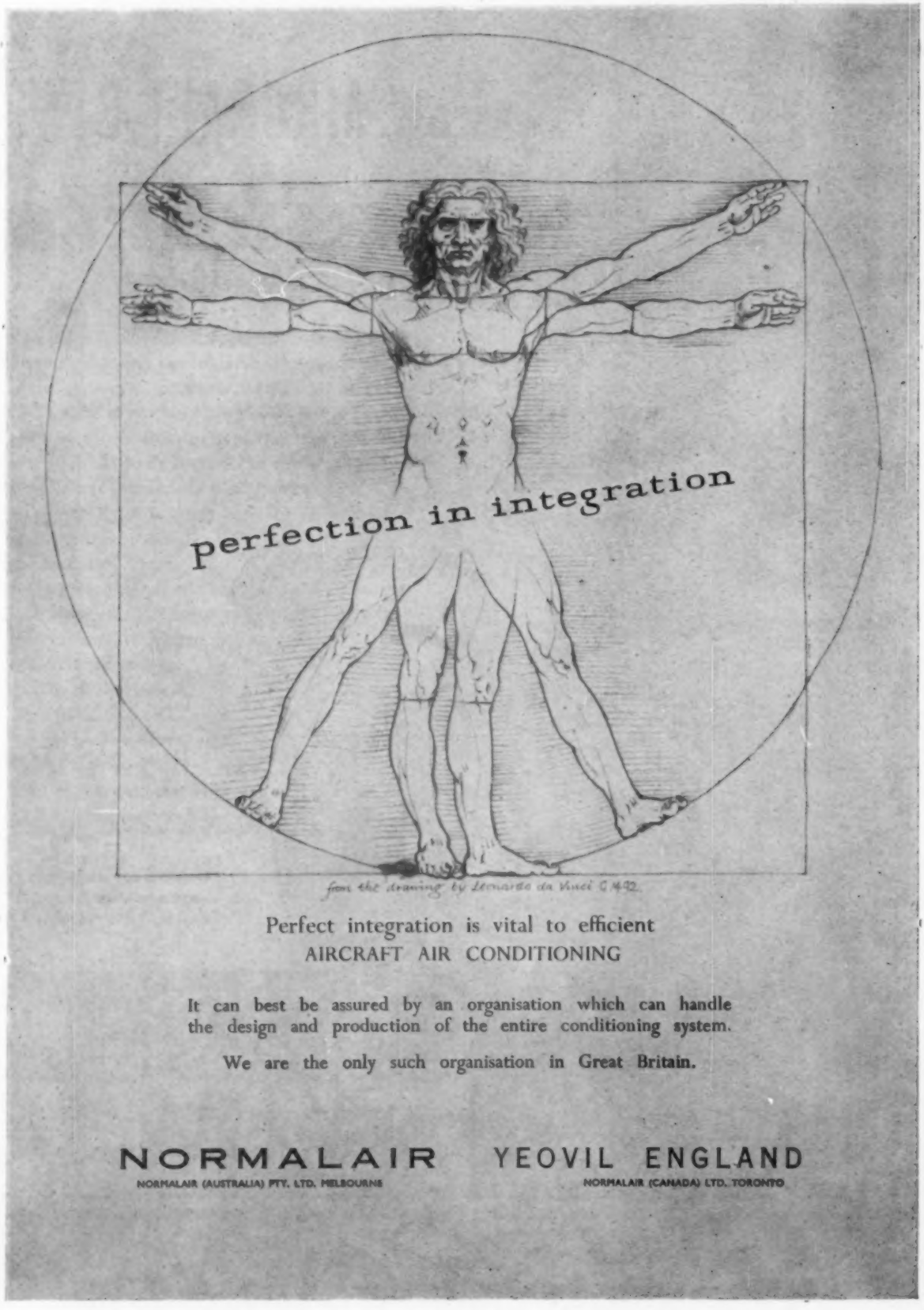

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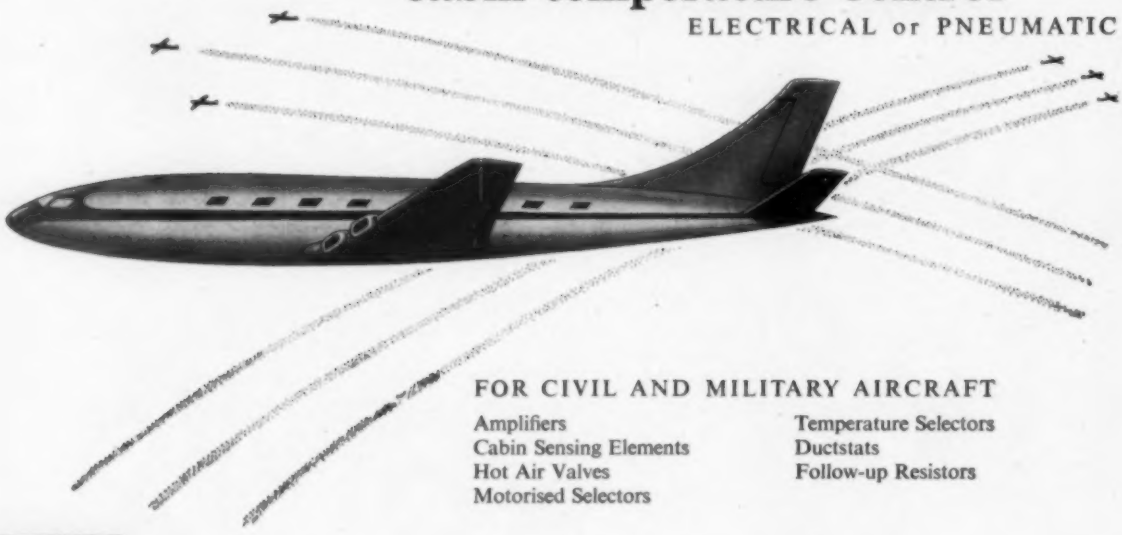

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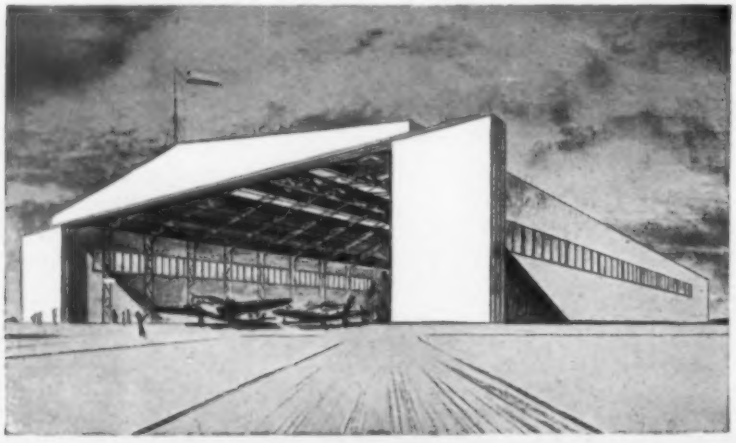

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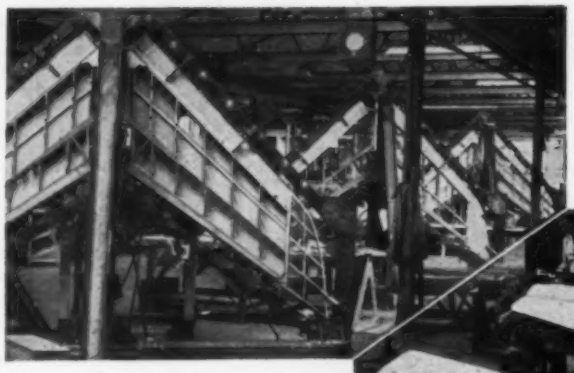

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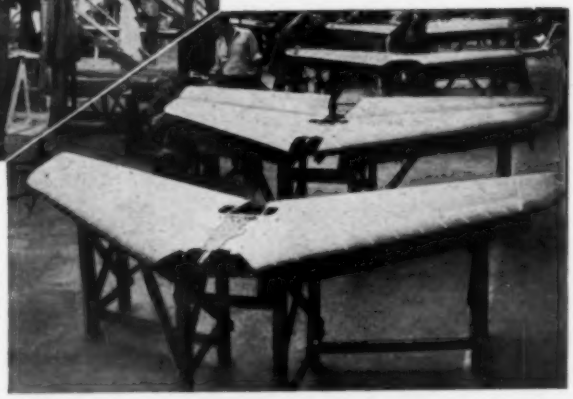

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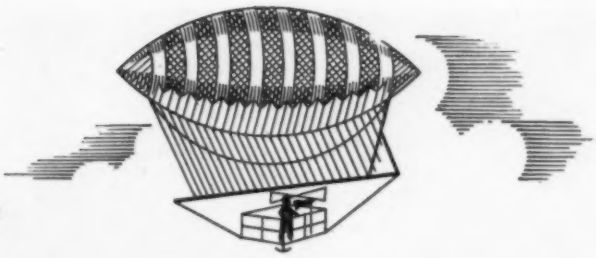

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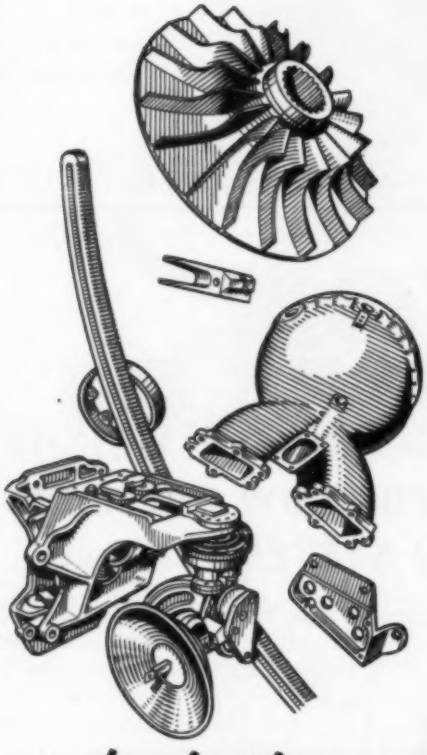

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FIRST AERONAUTICAL WEEKLY IN THE WORLD FOUNDED 1909

FLIGHT
and
AIRCRAFT ENGINEER

No 2495 Vol 70 FRIDAY 16 NOVEMBER 1956

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Secure in the Knowledge . . .

FOR longer than we care to remember we have been brooding upon, and occasionally chafing against, the anomalies and inanities of "security". In returning to that fraught and tiresome topic we refer to the recent Air Ministry communiqué which, describing an R.A.F. raid on Egypt, remarked that one of our Valiants was intercepted by a Meteor N.F.13.

It is necessary, perhaps, to apprise our readers that all marks of Meteor night fighter in service with the Royal Air Force—the N.F.13 among them—have precisely the same security grading as the Javelin or D.H.110; which means that *Flight* has never been permitted to describe the machine in any detail, to give particulars of its "secret" equipment, or to disclose its performance. Yet, for a period of many months, Egypt—"the instrument of Russia"—has been operating these potent night fighters alongside the Mig day intercepters supplied to her by the Soviet Union.

May we now hope that in the course of time, and with due protocol, procedure and ceremony, the "secrets" of the N.F.13 may yet be revealed to the patient and wondering gaze of the British Press and public? We look for no hasty decision in this matter (such as that whereby a Hunter T.7 was placed at the disposal of a Russian general while the British technical Press stood respectfully and enviously by); still less would we presume to suggest that British journalists might be authorized to sample the Javelin T.3, as a staff writer of *Aviation Week* has appraised the Convair TF-102. And we do, of course, recognize that in quoting the potential thrust of the Conway at "more than 15,000 lb," following disclosures in this country and America, we on *Flight* were guilty of deplorable technical turpitude and gross military insecurity. We should (we now perceive) have remained mute in this matter until the actual rating of 17,000 lb was proclaimed in the House of Commons by the Minister of Transport and Civil Aviation.

Up-and-Down Engines

SOMEWHAT remarkably we find ourselves introducing in this issue a new, large, British piston engine—the Bristol Centaurus 373 direct-injection unit for the Blackburn Beverley heavy freighter. The occasion is one not only for reflecting that this is probably the last of the great Bristol piston-engine family, but one for looking ahead to the possible future remaining for "up-and-down" aero engines of all classes.

It is tolerably clear that in all the major air forces the high-powered piston engine will be almost entirely superseded, during the years immediately ahead, by the turbojet or turboprop; only in the long-range maritime-reconnaissance class, typified by the Canadair CL-28, and possibly in the ultra-long-endurance early-warning category, is it likely to survive in first-line service.

In civil employment it may continue for some years to hold out against the gas turbine in fixed-wing light and medium transports (Herald, Safari, Twin Pioneer, etc.) and in utility machines such as the Otter; and during the same period it will remain in demand for helicopter installation. But, clearly, if ever an aircraft was made for (or perhaps we should say needed) the turboprop or gas generator it is the large- or medium-sized helicopter. Only in the smallest sizes of fixed-wing aircraft, in specialized agricultural machines and in the cheapest types of light helicopter has the reciprocating engine any reasonable hope of perpetuity, for there are no indications that turboprops or turbojets much smaller than those already available in the Turboméca range will prove efficient or otherwise worth-while. With advances in light-aeroplane design, however (and they have been appreciable in post-war years, as witness the newest American, French and Italian tourers) we should expect of the small up-and-downers greater reliability, coupled with minor improvements in efficiency and with some reduction in weight and complexity.

FROM ALL QUARTERS

Egyptian Lessons

WITH the return to their bases in this country last week of some of the R.A.F. Canberras and Valiants which had been engaged in attacks on targets in Egypt, those operations may be said to have officially ended, and it is possible to summarize the lessons gained.

Probably the chief is that our post-war Bomber Command, in action for the first time apart from small-scale deployment against Malayan bandits, is a weapon of great flexibility. The aircraft were operating from far-distant bases within a few hours of leaving their home stations. Thus, in addition to giving their crews first-hand operational experience, the home commands have proved they can swiftly reinforce the R.A.F. overseas at short notice.

Another lesson from the operations as a whole has been the important part played by carrier-borne aircraft, both fixed-wing and helicopter. The Admiralty has stated that the landing of paratroops at Port Said was probably unique in being the first such operation—as far as is known—to have been supported from the air solely by carrier-borne aircraft; and a large part of its success "must be attributed to the preliminary offensive by carrier-borne as well as shore-based aircraft against the Egyptian Air Force and its airfields." The Admiralty pays particular tribute to the control teams who landed with the first "drop" and subsequently directed the air support. On this day (November 5) over 370 sorties were flown from the carriers, the targets engaged being tanks, self-propelled guns, A.A. gun positions, troop concentrations, motor torpedo boats, aircraft on the ground and their hangars. Three Naval aircraft were lost, but all the pilots were saved.

Helicopters played a remarkable rôle in the Port Said operations. For the first time in British military aviation history, carrier-borne helicopters—operating from *Ocean* and *Theseus*, and reinforced by R.A.F. and Army helicopters—were used in operational landings, putting ashore some 500 men of the Royal Marine Commando within 91 minutes. A helicopter rescued the pilot of a Sea Hawk who had been forced to bale out 30 miles inland and some ten miles east of the Suez Canal; another, within 4,000 yd of shore batteries, picked up a Wyvern pilot; others performed the more routine duties of flying in medical supplies and evacuating wounded. Whirlwinds used for these purposes had to fly over about 100 miles of open sea on each round trip.

In all, carrier-based aircraft flew over 2,000 sorties. During the Port Said operation, on the evening of November 5, the Flag Officer Aircraft Carriers (Vice-Admiral M. L. Power, C.B., C.B.E., D.S.O. and Bar) received a message from the Army Commander ashore which said: "Many thanks for your magnificent support to us this day, which thrilled all ranks. Its timely effectiveness and accuracy were beyond praise and doubtless saved many casualties."

After the cease-fire, which became effective at 2358 hr on Tuesday, November 6, reconnaissance and defensive flights continued. During the next three days the Navy flew 56 such sorties.

Commenting last weekend on Col. Nasser's claim that Egyptian aircraft destroyed on airfields had been dummies, a Royal Air Force spokesman said that reconnaissance had established their reality "beyond all doubt." The most significant fact, however, was that the Egyptian Air Force had flown only two or three sorties —all ineffectual—against an air offensive designed to destroy it.

MARK OF APPRECIATION for S/L. Neville Duke on his retirement from Hawker test-flying: a silver Hunter model, presented by Mr. Neville Spriggs (managing director) on behalf of the Board.

The obvious inference was that the day and night attacks had neutralized the E.A.F., more than 100 of whose aircraft had been destroyed during the first two days.

An authoritative estimate given in Nicosia last Monday of the results of the bombing and ground strafing said that about 400 of the Egyptian Air Force's 500 aircraft had been destroyed. Only ten Il-28s were believed to have escaped to Saudi Arabia.

Russian Arms in Egypt

DETAILS of a build-up of Russian arms and technical manpower in Egypt and Syria over a period of more than a year were given by a British Government source in London [on Sunday last]. Military equipment to the value of £150m, it was estimated, had been sent to Egypt by the Soviet bloc, together with £20m of such equipment to Syria. The Egyptian arms included 50 Il-28 bombers and at least 100 Mig-15 fighters.

The bombers were stated not to have been used in the recent hostilities, and the fighters "only to a very limited extent." Most of the bombers appeared to have been flown out of Egypt, but many remaining aircraft had been destroyed on the ground. More than 1,000 technicians and instructors were believed to have been sent to Egypt before the outbreak of hostilities. Aircrews and mechanics were said to have been among about 300 Russians and Czechs who reportedly made for the Sudan from Egypt shortly after the Anglo-French intervention.

A New Bedstead

ON Monday of this week it was reported that an improved "flying bedstead" v.t.o. test rig had started its flight trials at Rolls-Royce, Hucknall. The machine is stated to have risen vertically and hovered for "several minutes," and to have made a second flight a short time later on the same day. Rolls-Royce decline to comment on the report.

That such a machine had been built was announced nearly a year ago, but no details are yet available of the improvements which have been incorporated. It is stated that the improved rig is generally similar in appearance to the original device.

Hollow Aluminium Blades

ON November 12 it was announced by the Hamilton Standard Division of United Aircraft that a C.A.A.-approved type certificate has been granted for a new design of propeller blade. Erle Martin, HamStan general manager, described the blade as "one of the most important steps forward in the past ten years."

In the past designers have had the option of using a hollow steel blade or a solid aluminium-alloy blade, the former being considerably more expensive but preferable in the very largest sizes. The new development will make available propellers capable of absorbing more horsepower per pound of weight than any previous pattern. The blades are extruded from light-alloy billets and are then flattened, twisted and partially filled with a

ASSAULT FORCE: Aboard the carrier H.M.S. "Theseus" troops and Whirlwind helicopters stand by as the smoke of distant fires streams over Port Said. Helicopters played an important part (see Col. 1).

cured synthetic-sponge stabilizing compound. A final coating of nickel plate provides protection from abrasion and erosion.

The new hollow-aluminium-blade propeller has been selected for the Lockheed L.1649A for T.W.A. and Lufthansa and the Lockheed Electras for K.L.M. The former type of aircraft has a very large three-blade propeller for which solid aluminium blades would be 50 per cent heavier than their hollow equivalent. The Electra has an appreciably smaller four-blade unit for which solid blades would be 27 per cent heavier. These weights do not, of course, take into account the reduced weight of hub, actuating mechanism and mountings which the lighter blades make possible, and in the case of the L.1649A the choice of the new propeller provides additional payload equivalent to four passengers.

Fairey Board Appointments

CERTAIN executive changes have been announced by the Board of the Fairey Aviation Co., Ltd. Mr. Geoffrey W. Hall, A.F.R.Ae.S., has been appointed a vice-chairman of the company (additionally to his appointment as managing director); Mr. Richard Fairey has been appointed a vice-chairman and has relinquished his appointment as general manager; and the following additional appointments to the Board have been made: Mr. Robert L. Lickley, B.Sc., D.I.C., M.I.Mech.E., F.R.Ae.S., to be technical director (retaining his appointment as chief engineer); Mr. John C. Macpherson, A.C.A., to be financial director (retaining his appointment as secretary); and Mr. Alan Vines, A.F.R.Ae.S., A.M.I.P.E., to be production director.

Mr. Lickley has been chief engineer of the Fairey Aviation

New Fairey directors: Messrs. Lickley, Macpherson and Vines.

Co. for five years. He was responsible for the successful development of the Gannet and the F.D.2; and the Rotodyne is being designed and manufactured under his control. Mr. Macpherson was appointed secretary of the company in 1944 and head of the financial department in 1952; he is chairman of the taxation committee of the S.B.A.C. Mr. Vines, who is also a director of Fairey Marine, Ltd., was responsible as production development engineer and later deputy chief engineer for prototype manufacture and for the development of the Fairey "envelope tooling" method of aircraft construction. He became production manager in 1950.

Leonides Majors in Bristol 173

ON November 9 the first Bristol 173 helicopter powered by Alvis Leonides Major engines started its flight trials. Based at the company's Weston Division, where all Bristol Aircraft helicopter work is done, it began its flight development with a series of hovering tests in the hands of Mr. C. T. D. ("Sox") Hosegood, chief helicopter test pilot.

Third 173 to be built, the new machine is stronger (to allow for a higher gross weight), has a higher rear rotor pylon (to improve efficiency and handling in gusty air) and is fitted with two 850 h.p. Leonides Majors driving four-blade interlinked rotors. Two more Major-powered 173s are near completion.

Second SeaMaster Lost

REMARKABLY bad luck seems to be dogging the Martin Company in their efforts to turn the P6M SeaMaster into a usable weapon for the U.S. Navy. On page 783 we publish an abstract from the report on the crash of the first prototype, which broke up in the air nearly a year ago. It is now learned that the second machine has also been lost over Delaware Bay, although details of the occurrence are not yet available. The crew of four, all Martin employees, escaped by parachute.

***FOUR-YEAR-OLD:** Built four years ago by S.N.C.A.S.O. to O.N.E.R.A. designs, this tiny experimental machine, measuring little more than 11ft in span and weighing only about 2,000 lb, has just been shown to the French Press. It bears the appellation "Delta Jet."*

***OVER 14 MILES UP:** First pictures, by radio, of the U.S. Navy balloon and its crew (Cdr. Morton L. Lewis, left, and Cdr. Malcolm D. Ross) after their November 8 attempt on the world's official absolute height record, which has stood at 72,395 ft for 21 years. They succeeded, by attaining—subject to confirmation—just over 76,000 ft. Note the parachute-type suspension of the pressurized gondola beneath the transparent-plastic envelope.*

The loss of this second machine is certain to prove a serious handicap in the development of the type, although it is too early to predict whether or not the production order, at present for 24 P6M-1s, will be affected. The production machines will be powered by Pratt and Whitney J75 engines and will be used in a variety of attack purposes.

Agricola Down Under

TOPDRESSING trials of the first Auster Agricola to operate in New Zealand began on October 25, only one week after the aircraft's first flight in that country. During the initial top-dressing operations, loads of between 7 and 12½ cwt were dropped (at 300ft and 90 m.p.h.) at a selected rate of 3 cwt per acre. The machine is said to have performed well from the strip in use, which was 150 yd long and sloping, in spite of crosswind conditions.

The Auster representative in New Zealand, Mr. E. C. Harrison, has reported that pilots of Airlift (N.Z.), Ltd., Rangitikei Air Services and Auster Air Services agree that "the Agricola has far better aileron control, general performance and landing characteristics than any of the American aircraft now operating in New Zealand."

New D.C.A. for New Zealand

SIR ARTHUR NEVILL, New Zealand's Deputy Director of Civil Aviation, has been appointed to succeed the retiring Director of Civil Aviation, Mr. E. A. Gibson. A former Chief of the New Zealand Air Staff, Sir Arthur was appointed Deputy Director in 1952. In 1955 he was elected a Fellow of the Royal Aeronautical Society. His connection with aviation dates from 1930, when he was transferred from the Royal New Zealand Artillery to the R.N.Z.A.F.

SHOT UP: A flak-damaged D.H. Sea Venom of No. 893 Squadron, H.M.S. "Eagle," returns from a Middle East strike and lands-on without benefit of wheels.

FROM ALL QUARTERS . . .

Peter Twiss Honoured

THE Derry and Richards Memorial Medal has been awarded for 1955 by the Guild of Air Pilots and Air Navigators to Peter Twiss, "for his work on high-speed delta aircraft leading up to the world air speed record runs." The research flights were carried out during 1955, and the record runs took place this year. The medal will be presented to Mr. Twiss at a banquet to be held by the Guild in the Mansion House next spring.

Sponsored by employees of the de Havilland Aircraft Co., Ltd., in memory of the late John Derry and Tony Richards, who lost their lives in a D.H. 110 at the 1952 Farnborough Display, the medal is awarded by the Guild annually for experimental flying. The two previous holders are W/C. J. H. Heyworth and W/C. R. P. Beamont.

Orpheus 2 Type Test

MAINTAINING its promise of rapid and successful development, the Bristol Orpheus turbojet has completed a declared type-test at 4,520 lb (BOr.2 rating). It is expected that the M.o.S. will grant a letter of approval at this rating and the engine is scheduled to go into production for the Folland Gnat next year.

It is also announced that "in order to obtain clearance for the temperatures which would be obtained at the operational-necessity rating at altitude, the engine was run at Orpheus 3 ratings, resulting in observed thrusts of over 5,000 lb during the whole of the running at take-off rating." The size of the fuel pump necessary for Orpheus 3 output (4,850 lb) precludes easy installation in the Gnat, so an additional pump was fitted to supply fuel at the required rate. The Orpheus 2 and 3 are otherwise identical, and the limitation on fuel-flow ceases at about 10,000ft and above. The engine has thus already been proved at the full 4,850-lb rating; the "over-5,000-lb" results were fortuitously due to the fact that, at the time of the test, the air temperature was well below i.s.a. conditions.

As we announced last week, Finland has become the seventh country to buy the Orpheus. It was previously selected to power the Fiat G-91, already flying in Italy, together with the Bréguet 1100 Taon and Dassault Etendard VI (France), the Hispano HA.300 (Spain), the Ikarus B-12 (Yugoslavia) and the Fuji TIF-1 (Japan).

Antarctic Air Activity

AT McMurdo Sound, in the Antarctic, a landing strip has been created by pumping sea-water from beneath rough pack ice to form a smooth frozen surface. It has been made for use by American aircraft during operations connected with International Geophysical Year research. A C-124 Globemaster has flown in with stores and altogether 500 tons of equipment and 300 tons of fuel are to be landed.

Meanwhile Australian aircraft, operating from the Commonwealth's Antarctic base at Mawson, have discovered an uncharted ice shelf gulf, a hundred miles long, near Amundsen Bay in Enderby Land, about 400 miles west of the base; they have also observed a gigantic new glacier flowing down from the Antarctic mountains to Prydz Bay.

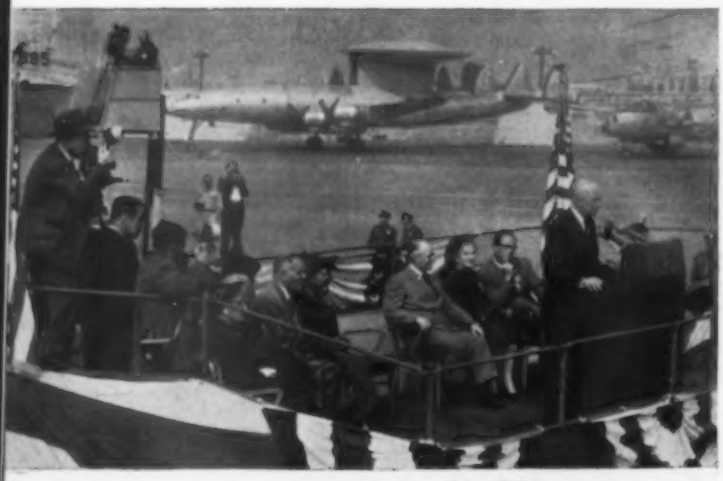
Technical Manpower Forecasts

THE annual output of qualified scientists and engineers in Britain should be increased by over 60 per cent by 1966 and 100 per cent by 1970, according to a recently published report (*Scientific and Engineering Manpower in Great Britain*: 1s. 6d., H.M. Stationery Office). The document contains the results of enquiries into the respective short-term and long-term demands for scientists and engineers made by the Ministry of Labour and the Committee on Scientific Manpower of the Advisory Council on Scientific Policy.

Of an estimated 134,700 qualified scientists and engineers (i.e. those with a University degree or equivalent qualification) in this country, the Ministry's survey indicates that some 43 per cent are at present employed in the manufacturing industry. Aircraft manufacture is stated to employ 4,300 qualified scientists and engineers, equivalent to 1.9 per cent of the total number employed in that industry. The proportion of such qualified staff engaged on research and development is stated to be "well above average" in the aircraft industry, the "average" figure for the manufacturing industry as a whole being 45 per cent.

PRESIDENTIAL SELECTION

Mr. Eisenhower's Latest Constellation

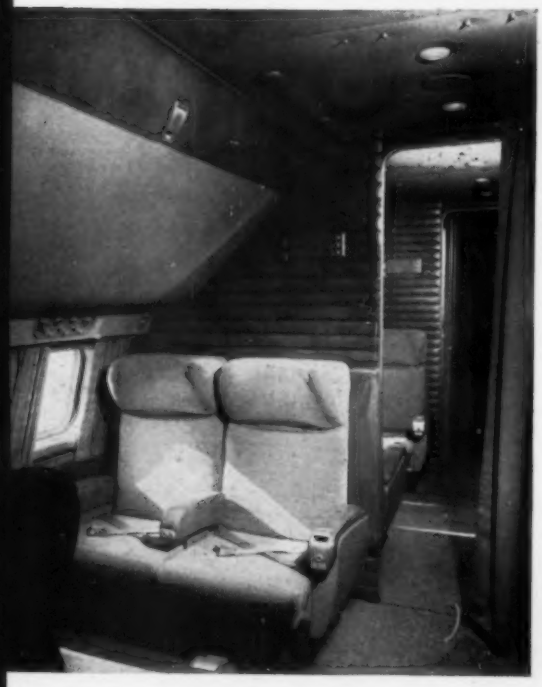


TRAVEL may broaden the mind, but it can equally absorb much of the precious time of busy men. The modern solution is to turn travelling time to good account; and in the past decade, a flourishing market in aircraft furnished as offices, boardrooms and sleepers has been developed for the top executive.

Few men can have such urgent demands upon their time as the President of the United States of America. Mr. Eisenhower, now facing a new four-year term of office, has used a succession of specially-equipped Constellations for some years—ever since, in fact, he was presented with one by the U.S. Government while he was commander of S.H.A.P.E. in Europe.

On the eve of his recent re-election, the President paid a first—and non-political—visit to Burbank to thank the employees of the Lockheed Aircraft Corporation for the good service that he had received from his three personal Constellations. Each aircraft has been called *Columbine*—no Shakespearian reference, but called after the state flower of Colorado, which was Mrs. Mamie Eisenhower's home. The presidential aircraft on the tarmac was *Columbine III*, a new Super-G in the restrained anonymity of U.S.A.F. markings, and lacking any of the external embellishments that might be expected of a Head of State.

Far from flamboyant, interior furnishings are well-styled and comfortable; drop-down bunks supplement the airline seats; and heavy carpeting and padded soundproofing of the cabin compartment divisions reduce the noise to a presidentially appropriate level.



In the throes of his election campaign, President Eisenhower found time to thank Lockheed for the comfort and reliability of his newest Super-G. Seen mounting the speaker's platform (escorted by Lockheed chairman Robert E. Gross) and talking to a crowd of 24,000 in front of the radar-sentry and a Neptune, the President compared his aircraft to "a flying White House." "Columbine III" has a teletype machine installed to enable those aboard to maintain contact with Washington.

Mr. Eisenhower, who addressed 24,000 people at Burbank (not all of them Lockheed employees), said that he had travelled 225,000 miles in his personal Constellations—but "that, of course, is only a fraction of the distance they have gone in all. The present *Columbine*, like the other two, is trustworthy and reliable; and, above all for me, it is comfortable. It is a place where I can work. It is roomy and commodious. It is, in fact, a flying White House. So you can see that I feel a real debt of gratitude to all you people."

HERE AND THERE

MAJOR IMPROVEMENT: Although superficially very similar to its predecessors, XE 286, the third Bristol 173, is really extensively improved. Two Alvis Leonides Majors provide 65 per cent more power, as noted in a news-item on page 775.

Hustler Airborne

THE prototype Convair B-58 Hustler—America's first supersonic bomber—made a successful first flight at Fort Worth on November 11. It was airborne for 38 min.

Polish Pilots Recalled

AMONG officers recalled to active service in Poland following the recent changes are Maj. Stanislaw Skalski, one of the top-scoring wartime Polish fighter pilots in Britain, and Maj. Witold Lokuciewski, who formerly commanded No. 303 (Polish) Squadron, R.A.F.

Aero-medical Concentration

THE U.S.A.F. has announced plans to build a multi-million-dollar centre for research into the physiological aspects of supersonic flight. Situated at Brooks Air Force Base, near San Antonio, Texas, it will bring under one roof the Air Force's School of Aviation Medicine (the school is at present partly in Texas and partly in Alabama).

Public Relations Award

THIS year's award of the C. P. Robertson Memorial Trophy has been made to Marshal of the Royal Air Force Sir John Slessor in recognition of his work in "interpreting the R.A.F. to the public"—notably by his book *The Central Blue*. The award, announced by A. Cdre. Willoughby de Broke at last Friday's reunion of the Air Public Relations Association, commemorates the late Mr. C. P. Robertson, founder of what is now the Information Division of the Air Ministry.

"Southern Cross" for Brisbane

FIRST aircraft to be flown across the Pacific—from Oakland, California, to Brisbane, Queensland, in 1928—the Fokker F.VII/3m *Southern Cross* is to be permanently housed at Brisbane, birthplace of its pilot, Sir Charles Kingsford Smith. The machine was purchased by the Australian Government 21 years ago, and it is now intended to preserve it in a special building at Eagle Farm Airport, Brisbane. A public appeal is being launched for funds for the construction of the building.

A. F. C. ROBERTS has joined Short Bros. and Harland, Ltd., as a junior test pilot. He is a former member of No. 615 (County of Surrey) Sqn.

First-hand Account

ON November 20, B.B.C. television is presenting a feature programme on Sir John Alcock and Sir Arthur Whitten Brown. The former's brother will be interviewed and films and photographs shown to describe their pioneer Atlantic flight in 1919. This will be the first of a new series of programmes—called *First Hand*—on aviation subjects. The second, about flying saucers, is to be shown on December 4.

FLOATPLANE: One of the floats in the Lord Mayor's Show last Friday carried a one-fifth-scale model of the Fairey F.D.2. The theme of the Show was "aluminium," and the British Aluminium Co., Ltd., was responsible for the preparation of the numerous special exhibits.

Helicopter Records

WORLD records are likely to be claimed for a Sikorsky S-56 which, last weekend, attained a speed of 162.7 m.p.h. and reached 12,000ft with an 11,050-lb payload and 7,000ft with 13,250 lb.

A.I.T.A. Appointment

AT the recent annual general meeting of the Air Industries and Transport Association of Canada, Mr. J. Geoffrey Notman, O.B.E., was elected president of the Association for 1956-57. Mr. Notman is president and general manager of Canadair, Ltd., Montreal.

Handley Page Exhibition

AN exhibition illustrating the history of Handley Page, Ltd., is on view in the information room at Unilever House, Blackfriars, London, E.C.4, daily (except Saturdays and Sundays) until November 23.

Undoing Moby Dick

ON board the Norwegian whale factory ship *Norhval*, operating in the Antarctic, is a Westland Whirlwind. It is used primarily to find channels in the ice ahead of the ship, but it may also be employed in spotting whales.

R.Ae.S. Party

ANNUAL dance of the Graduates and Students Section of the Royal Aeronautical Society will be held at 4 Hamilton Place, London, W.1, from 8 p.m. to 11.45 p.m. on November 30. Tickets, price 7s 6d including refreshments, are obtainable from Mr. Michael Laker, 65 Sundale Avenue, Selsdon, South Croydon, Surrey.

D.H. Old Boys Dine

THERE can be few aeronautical bodies whose members are more widely distributed throughout British and foreign aviation than the Old Boys' Association of the D.H. Aeronautical Technical School. The Association's annual London dinner at Simpsons last Saturday was, as always, an occasion for the exchange of lively reminiscence. Guest of honour and principal speaker this year was Mr. R. H. Bound, F.R.Ae.S., M.I.Mech.E., A.M.I.A.E., F.S.E., technical director of the Dowty Group. Among those present were Mr. J. L. P. Brodie (president), Mr. F. T. Hearle (past president), Air Marshal Sir Ralph Sorley (vice-president), Mr. R. E. Hardingham, and W/C. R. A. C. Brie.

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POLISH AIRCRAFT DEVELOPMENT

—*in the Post-war Era: Part I*

By J. B. CYNK

THIS article was written before the recent political events in Poland. It should, therefore, be read with the proviso that the Polish aircraft industry may now be at the beginning of a new era, less subject to Russian control. The author's description of the post-war period—with its evident frustrations—forms an admirable basis for studying future developments.

MUCH scattered news has recently been published in various aeronautical periodicals concerning Polish aircraft now under development. It is very difficult, however, to form a comprehensive picture of the present activities of the Polish aircraft industry from this information, and a review of the main events of post-war aeronautical development in Poland makes an interesting study. It reveals several factors which have been overlooked, and which have exercised great influence on aviation progress, not only in Poland but also in other satellite countries.

The Polish aviation industry was completely wiped out during the last war, and when the Germans retreated no production facilities whatsoever were left. Soon after hostilities ceased, steps were taken to organize research and design centres, and to start aircraft production. It was decided that, as far as possible, the country's need should be met by nationally designed aircraft; and the task of design and development of prototypes was given to the L.W.D.—Lotnicze Warsztaty Doswiadczalne (Aircraft Experimental Establishment)—at Lodz, and to the C.S.S.—Centralne Studium Samolotow (Central Aircraft Office) subsidiary of Z.P.L. (Aircraft Industry Trust)—in Warsaw. P.Z.L.—Panstwowe Zaklady Lotnicze (State Aircraft Factories), with factories at Mielec, Rezeszow, Psie Pole and Wroclaw, were given the responsibility for series production of approved types. In 1947, Gil-Glowny Instytut Lotnictwa (Chief Aviation Institute) was established in Warsaw with functions similar to those of the Russian TsAGI.

L.W.D., under its chief designer Dipl. Ing. Tadeusz Soltyk, formed the oldest and most active post-war establishment. During the last stages of the war Soltyk designed at Lublin a primitive light aircraft for liaison duties, known as the Szpak 1. When the Germans retreated farther west, he moved his office to Lodz, where L.W.D. was established permanently. A new aircraft, the Szpak 2, was developed from the previous project, and work on the prototype started in a disused furniture factory under extremely difficult conditions. The first flight of the Szpak 2 (registered SP-AAA) was made on November 10, 1945.

This four-seat trainer/tourer was a low-wing cabin monoplane, with a fixed tail-wheel undercarriage and powered by a 150-h.p. Siemens Sh-14 radial engine. The fuselage was a fabric-covered tubular girder structure and the wings, of two-spar semi-cantilever wooden construction, were braced to the fuselage by two parallel streamlined duralumin tubes on each side. Slotted flaps and Frise-type ailerons were fitted. The span was 37ft 1in, length 26ft 11in, gross weight 2,645 lb, maximum speed 126.6 m.p.h., range 405 miles, and ceiling 14,700ft.

A line-up of standard production L.W.D. Junak 2s.

In January 1947 the Szpak 3 was test-flown. This was an experimental nosewheel version of the Mk 2, and the sole purpose of this version was to gain experience with a tricycle undercarriage arrangement.

The Szpak 4 was a production development of the Mk 2 with "V"-shaped struts employed to facilitate entrance to the cockpit. Two versions were built—the Mk 4a, a two-seat aerobatic trainer with open side-by-side cockpit (only one machine was completed), and the Mk 4T, a four-seat trainer with improved cockpit arrangements. A series of ten of these was built by P.Z.L. at Mielec.

The next L.W.D. design was the Zak 1 primary trainer with a 65-h.p. Walter Mikron III engine (the first flight was in April 1947). This low-wing cantilever monoplane, with side-by-side seating for two and fixed tail-wheel undercarriage, was in many respects similar in construction to the Szpak series; but the wing was quite different, with one main spar and an auxiliary diagonal centre-section spar.

An open-cockpit Zak 2 was flown in January 1948, powered by a Continental A-65 flat-four engine of 65 h.p. Although large-scale production of this aircraft (with P.Z.L.-built A-65s) was envisaged, this particular combination did not materialize, as the engines were not produced.

The Zak 3 was a production variant of the Mk 1 and was, indeed, almost identical with it. Span was 38ft 11½in, length 24ft 11½in, gross weight 1,365 lb, maximum speed 97 m.p.h., range 190 miles, and ceiling 11,500ft. L.W.D. completed a batch of nine Zak 3s in December 1948. Only a prototype Zak 4 was built: this aircraft, which was an open-cockpit glider-tug, was equipped with a 105-h.p. Mikron IV, and was test-flown in October 1948.

To meet the requirements of Polish flying schools, the prototype L.W.D. Junak 1 two-seat trainer was specifically designed. This was powered by the Russian 125-h.p. M-11G five-cylinder radial engine, enclosed in a typical Russian-type helmeted cowling, and the aircraft first flew on February 2, 1948. In the design stage provision was made for the fitting of a 160-h.p. Franklin flat-four engine, specified for the production model. As the manufacture of American engines was not allowed in Poland, however, the design was modified to take a Walter Minor 6-III six-cylinder engine. The prototype, known as the Zuch 1, made a preliminary flight on September 2, 1948, after some alterations to the cockpit layout and the fitting of a cleaned-up cantilever undercarriage. The specified engine also proved difficult to obtain in substantial numbers, and the Zuch 2—powered by the German 150-h.p. Bramo (Siemens) Sh-14 seven-cylinder radial—appeared on April 1, 1949. This mark was basically identical with the Zuch 1, but, as the retreating Germans left behind only a few Bramo radial engines, it was not possible to build many with these fitted.

At this time, the design of the Junak 2 had been completed: this was, in fact, a production version of the Junak 1, incorporating the experience gained with previous types, and equipped with the only available engine—a Polish-manufactured Russian radial of 160 h.p. designated M-11RF. This aircraft was a fully aerobatic trainer of low-wing cantilever monoplane layout, and seating two in tandem beneath a long, "glass-house" canopy. Wings of trapezoidal plan-form were built in three sections, the centre section forming an integral structure with the fuselage and the outboard sections being of wooden two-spar torsion-box construction. Statically and aerodynamically balanced Frise-type ailerons, manually-operated flaps from aileron to aileron, and an aerodynamically balanced rudder were employed. The fuselage was fabric-covered, with a welded tubular steel frame, light plywood ribs and wooden longerons. The cantilever tail unit had a plywood and fabric covering. Full night-flying

POLISH AIRCRAFT DEVELOPMENT . . .

equipment was fitted. Span 32.8ft, length 25.9ft, gross weight 2,185 lb, maximum speed 149 m.p.h., range 310 miles, ceiling 13,780ft.

The first Mk 2s were delivered to the aero clubs at the beginning of 1954. A new version, the Junak 3, is at present in production, deliveries having started towards the end of last year. The "3" is basically a "2" with a nosewheel undercarriage and full radio equipment, and is intended mainly for military training. The total number of these two marks built up to now approaches 100. Some are flying with the helmeted engine cowling, and some without it, the latter machines having the cylinders exposed.

In the autumn of 1949 the L.W.D. Mis was test-flown. This was a shoulder-wing feeder-liner seating eight passengers with a crew of two, and powered by two 240-h.p. Argus As 10C engines. The all-wooden wing of trapezoidal, two-spar torsion-box construction was built as an integral structure. Frise-type double ailerons were statically and aerodynamically balanced, and flaps were fitted on the remaining length of trailing edge. The welded tubular steel fuselage was metal-covered over the forward section and the centre-section had a fabric covering, whilst the rear was of wooden, semi-monocoque construction. Full radio equipment was carried. This design, built only in a prototype version, had a fixed nosewheel undercarriage, with the main wheels strutted to the fuselage. Span was 58ft 1in, length 41ft 11¾in, gross weight 7,050 lb, maximum speed 162 m.p.h., and range 470 miles.

The last aircraft to be designed and built by L.W.D. was a high-wing, strut-braced two/three-seat cabin monoplane of composite construction, known as the Zuraw. The first flight was made on May 6, 1951. Designed for liaison and air observation post duties, the Zuraw was intended for operation from unprepared ground. It had a 160-h.p. M-11RF engine, but proved to be underpowered. The wooden two-spar wing, folding for storage purposes, was of NACA 23012 section with full-span slats, slotted ailerons and large manually operated flaps with 40 deg deflection, enabling a landing to be made from the stall. The fabric-covered fuselage of welded steel-tube frames and wooden longerons ended in a wooden, strut-braced tail unit covered with plywood and fabric. A very strong undercarriage, with oleo-pneumatic shock absorbers, had been fitted. The span was 28ft 4½in, length 27ft 1½in, gross weight 2,550 lb, maximum speed 110 m.p.h., range 600 miles, and ceiling 8,200ft.

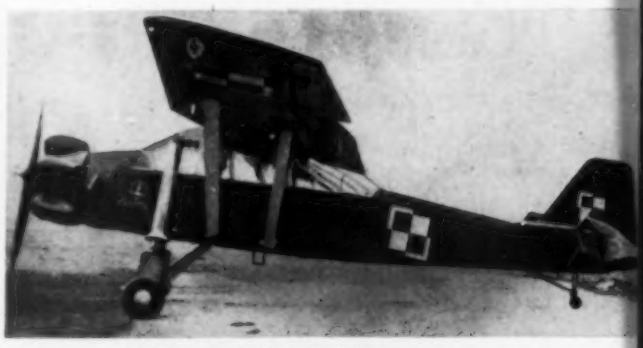
Two more projects had to be abandoned when the L.W.D. was dissolved. These were the Goniec basic trainer, with an estimated maximum speed of 190 m.p.h., and the Bies aerobatic trainer. L.W.D. was also responsible for the overhaul of several Piper aircraft, and for converting some of them into air ambulances.

C.S.S. This concern was established in 1946 under the direction of a well-known pre-war P.Z.L. designer, Professor F. Misztal (chief designer). The object of C.S.S. was to construct three basic types of aircraft, namely, primary trainers, aerobatic trainers and light commercial machines.

The first aircraft, designated C.S.S.10a, was flown on September 3, 1947. This was a two-seat open-cockpit low-wing cantilever monoplane of mixed construction, with a fixed tail-wheel undercarriage, and powered by a Walter Mikron III engine of 105 h.p. Only the prototype was completed.

Following this came the C.S.S.11 aerobatic trainer, which first flew in October 1948. Though of similar construction and appearance to the 10a, its wing was of a different plan-form and the powerplant was the 160-h.p. Walter Minor 6-III. Only two examples were built.

In 1948 work began on the C.S.S.12, a low-wing feeder-liner, and the aircraft was flown on November 22, 1950. The power-



L.W.D. Zuraw I of the Polish Air Force.

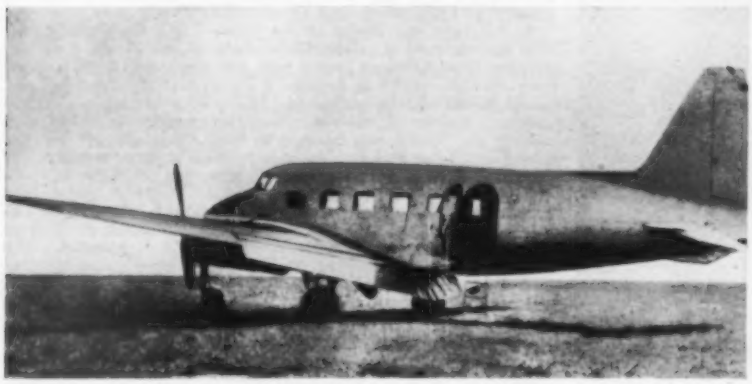
plant consisted of two 440-h.p. inverted-vee-12 Argus 411TAs, fitted with single-stage superchargers, and driving two-bladed metal Argus-type automatically controlled feathering propellers. The wings were built in three sections, the centre section being integral with the fuselage; the outboard panels were of changing section, namely NACA 23009 at the tips and NACA 23018 at the inner end. Two spars completed the all-metal integral box, to which leading and trailing edges of the wing were attached. The skin comprised both corrugated and smooth duralumin sheets, the corrugated areas being covered additionally with fabric, as also were the ailerons, which were of the split type with differential operation. Full-span, double-slotted, camber-changing flaps between the ailerons and fuselage were supplemented by a single plain central flap equal in width to the fuselage, and designed to smooth out turbulent airflow under the fuselage area when the main flaps were fully extended. The flaps were hydraulically operated, and could be locked automatically in any position. De-icing had been provided for the whole of the leading edge, utilizing air heated by the engine exhaust. The fuselage was an all-metal, stressed-skin, semi-monocoque, oval structure of duralumin longerons and frames.

The crew compartment had dual controls and the two sets of instruments included blind navigation aids, radio-compass, two-way radio and an autopilot. Two rows of ten forward-facing seats were a typical seating configuration, with the toilet and luggage compartment situated in the rear part of the fuselage, behind the passenger cabin; and 500 lb of freight could be accommodated.

The tail unit, of cantilever all-metal construction, including its covering, had a de-icing system similar to that for the wings. The fabric-covered rudder and elevators were statically and aerodynamically balanced, and fitted with manually adjustable

The GIL helicopter, the first to be designed in Poland.

The prototype C.S.S. 12 light feederliner.



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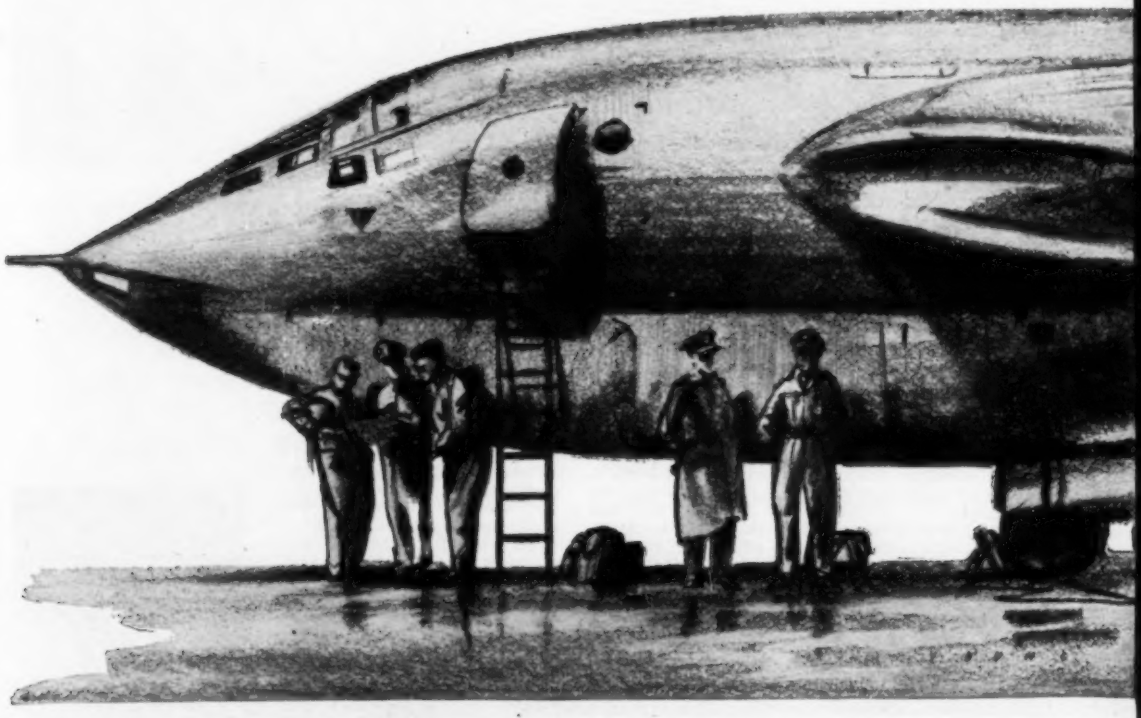
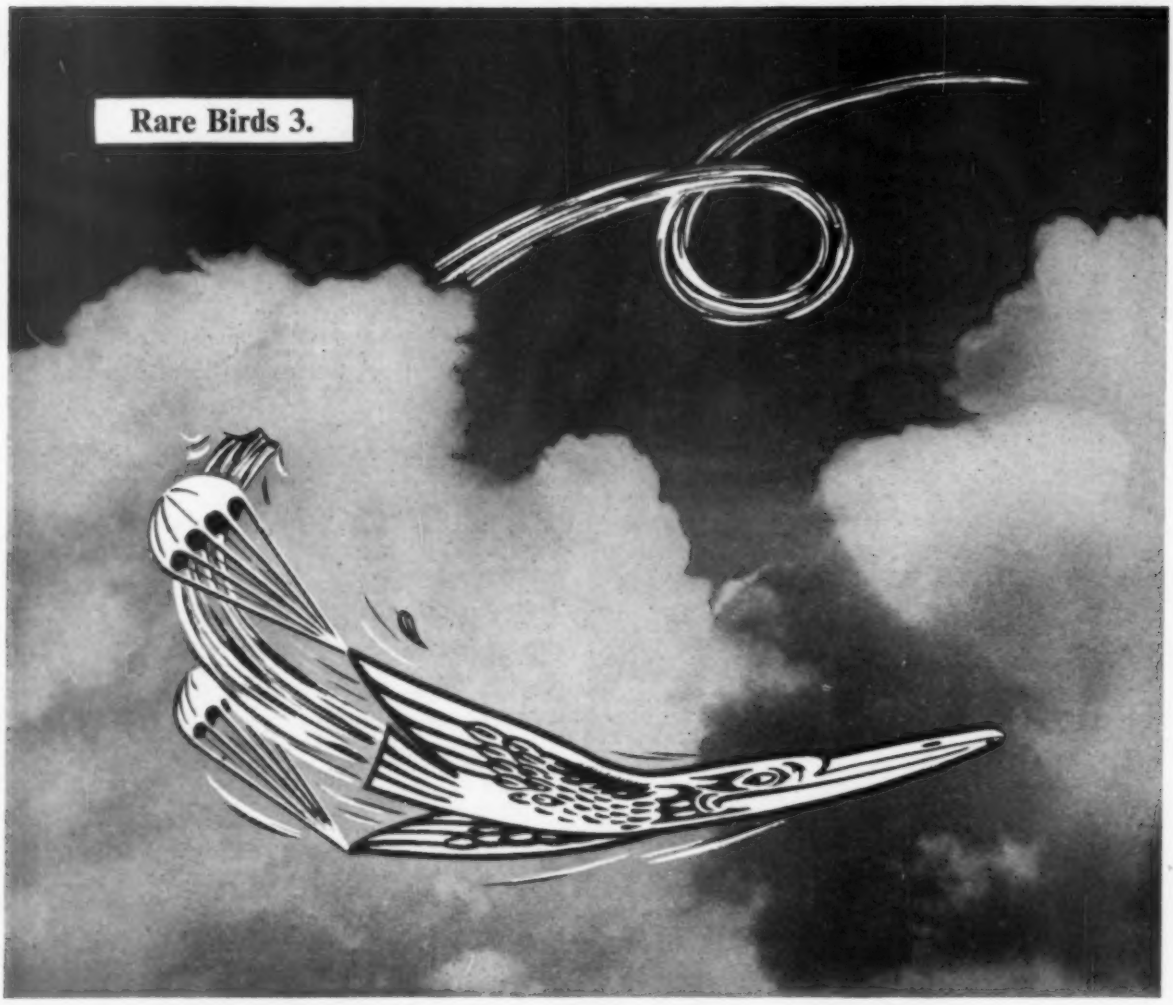
The development potential of the crescent-winged Victor will ensure that it maintains its position as Britain's premier strategic bomber.



HANDLEY PAGE *RADLETT · LONDON · READING*



It is rumoured that . . . . . .

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POLISH AIRCRAFT DEVELOPMENT . . .

trim tabs. The nosewheel-type undercarriage, hydraulically retractable, was fitted with oleo-pneumatic shock absorbers. The C.S.S.12 had a span of 60.72ft, with length 41.02ft, height 16.81ft, wing area 431.64 sq ft, weight empty 7,717 lb, gross weight 12,127 lb, maximum speed (at 8,000ft) 227 m.p.h., cruising speed 199 m.p.h., service ceiling 19,700ft, and range 745 miles.

In the meantime, C.S.S. started to build under licence the general-purpose Russian Po-2 biplane, and this was designated C.S.S. 13. Scores of these aircraft were completed and are now used in Poland for agricultural and ambulance duties, as well as for training, glider-towing and liaison work. C.S.S. was dissolved in 1950.

P.Z.L. This concern consisted only of a small design office, under the direction of Dipl.Ing E. Stankiewicz, before it was allotted the task of aircraft production. Then a prototype was built of the S-1, a two-seat open-cockpit high-wing parasol monoplane of wooden construction, with plywood and fabric covering. A 125-h.p. Russian M-11D five-cylinder radial engine with a Townend ring was fitted. The first flight took place on November 15, 1945.

Later Stankiewicz designed another high-wing monoplane intended specifically for glider-towing. This aircraft, known as the S-3 Kania, was built by S.Z.D. (Experimental Glider Establishment), which was usually concerned only with glider construction. The engine was a 125-h.p. M-11D, and the aircraft first flew on April 1, 1951. Despite its good performance, and the pressing need for such a glider-tug, the Kania did not go into production.

G.I.L. In the summer of 1950, the maiden flight of the GIL helicopter took place. With the exception of some early work by Tanski [see *Flight* for July 27, p. 174], this was the first helicopter built in Poland. The first proposals for this machine were made in 1946 by Z. Brzoska, but the real work on the project did not start until the spring of 1948. The main credit for the final design must go to B. Zurakowski.

This experimental helicopter, with a two-bladed main rotor and an anti-torque tail rotor, had an open cockpit with side-by-side seating for two. The fuselage, to which a tricycle undercarriage was fitted, was built in two parts: a welded tubular forward structure, with a specially adapted 100-h.p. Hirth engine behind it and the main rotor immediately above; and a plywood monocoque tubular boom carrying the tail rotor and its controls. The two rotor blades, of NACA 43012A section, were carried on a universally mounted head. The maximum rotor speed was 272 r.p.m. and the maximum forward velocity 87 m.p.h. Rotor diameter was 28ft 11in, the gross weight 1,280 lb, vertical ceiling 3,300ft and range 110 miles.

Apart from work on helicopters, G.I.L. also helped to develop an ultra-light, single-seat cabin monoplane, designed by T. Chylinski, powered by a pusher 31-h.p. flat-four two-stroke GAD engine (designed by Gajecki). The machine was called the Pegaz, and first flew on July 16, 1949. Although it proved a winner in the 1947 design contest for an ultra-light aircraft, only the prototype was built.

On the whole, during the first five years after the war, Polish designers were very active, and did their best to overcome very difficult conditions; but the lack of official interest in their work, and the disastrous situation in the engine field—the only powerplant available in numbers being the Russian M-11RF—invalidated much of their effort.

(To be concluded)

Fair Play for the Helicopter

A Critic Challenged

By BASIL ARKELL

IN his article "How Fares the Helicopter?" in *Flight* of November 2, John W. R. Taylor reviews the "state of the art" in the rotating-wing field and complains of the lack of progress in this country. No one will disagree with him that more rapid progress would be desirable; but more than one premise on which he bases his ideas is open to immediate challenge. Moreover, although he concludes with the plea that "the time has come for helicopters, not excuses," he offers no clear indication as to how this objective is to be achieved. Indeed, one feels that his criticisms are inclined to be somewhat confused and, at times, aimed at the wrong target.

It is important that the picture should be viewed in its true perspective. The decision taken earlier this year by the Ministry of Supply to restrict its official support to only a limited number of helicopter projects in this country, and in certain cases to cancel the contracts altogether, was in no way related to any desire to achieve a measure of standardization within the British helicopter industry. Based on such a premise, agreement with its decision would never be endorsed even by the Ministry itself, because it simply is not true. The decision was reached, with no little reluctance, entirely as a result of financial considerations. It is as fully appreciated in Ministerial circles as anywhere that the existence of a wide variety of design-projects provides one of the most healthy stimuli to any industry.

In the United States, there were no fewer than 75 different helicopter design projects in varying stages of progress by the end of the second world war and it is upon this sound foundation that the present strength of the American helicopter industry is based. Sometimes a "one-off" prototype may yield only information on how *not* to approach a problem; but even this knowledge can be of great value. Attempts made to develop a number of minor projects in this country during the last ten years have fallen by the wayside mainly owing to limited financial resources. Even now, an increase in the variety of design-projects could be of immense benefit as a stimulus to the British helicopter movement. For convincing proof, one has only to look at the motor car industry. There is no lack of inventiveness on the part of British designers; the writer has personal knowledge of three novel rotating-wing projects including one autogyro, a type which is by no means dead. These need only financial backing to bring them to practical realization; and there are, undoubtedly, many others.

In contrast to Mr. Taylor's contention, there is little doubt that if the Ministry of Supply were not so severely restricted by financial considerations it would have no hesitation in giving contractural support to a much wider variety of helicopter designs than it was able to do even before the recent curtailment. The spirit is willing but the flesh is weak.

Another unfortunate aspect of the restricted development policy that has been forced upon us is apparent in the repercussions among the specialist helicopter engineers and technicians themselves. If the redundant helicopter design teams were being encouraged to swell the ranks of those engaged on existing projects, in order to obtain increased production of a smaller variety of types, there might be something to be said for a policy of standardization as a temporary expedient. But this is not the case, and the discouragement thus engendered in the minds of engineers who are finding that they can no longer use the experience gained during perhaps five or ten years in the study of rotating-wing problems is felt even more widely than at first appears.

In the country's technical schools and colleges, where the younger generation of engineers is being trained for its future rôle, the helicopter branch of the aeronautical sciences, although attractive, is regarded with understandable misgivings by students. They naturally wish to enter a field which offers some stability and continuity for their future work; so the majority turn to supersonic or guided weapon projects. In this way, many promising young men are lost to the helicopter industry even before they start, in spite of the fact that some of them have made quite worthwhile contributions to rotating-wing science in the form of theses prepared while still within their academic precincts.

If future development is to be safeguarded, a way must be found of encouraging these young men to apply their energies permanently to the solution of rotating-wing problems.

It is easy to blame the industry for not displaying sufficient initiative, but such an attitude takes no account of the solid contribution that has already been made by the private enterprise of those companies which comprise the helicopter industry. It is too often forgotten that more than half the helicopter projects currently in design and production in this country were begun as private enterprises by the individual manufacturing firms. Such a record leaves little room for adverse criticism and its omission does less than justice to the companies concerned. Today, research and development costs are so astronomic that the industry cannot possibly bear the whole burden on its own shoulders. It must have support in the form of development contracts or reasonably large production orders before an expensive programme can be embarked upon.

It is true that apathy in high places—and, in some cases, a frank disbelief in the helicopter's future—has been responsible for retarding development. In fact, such an attitude is not unknown in certain sections of the aircraft industry itself. Its effect can best be counteracted by creating the conditions in which the helicopter is able to demonstrate its unrivalled advantages in public and sell itself to the sceptics. But how are these condi-

FAIR PLAY FOR THE HELICOPTER . . .

tions to be created; and how is the helicopter movement in this country to be injected with a vigour that will produce the support so urgently needed by the British manufacturers?

At the last annual dinner of the Helicopter Association, the president, Lord Brabazon, reminded us that in London Airport alone there was enough concrete to build a two-lane highway between London and Edinburgh. Nearly £30 million has been spent on its construction; including depreciation, it is losing money at the rate of approximately a million a year. The scheme to enlarge Gatwick Airport as an alternative to London is estimated to cost £15 million; and already, before it is even halfway toward completion, it appears that investigations are in progress to find a suitable site north of London for use as a *second* alternative. Presumably, another £15 million will soon be required.

When the high initial cost of helicopters is criticized, it should be remembered that it is in such terms as these that the fixed-wing aircraft industry is being subsidized. Apart from this, many aeroplane operators receive some form of direct subsidy, either as mail or trooping contracts. Alone, out of all means of transportation, the helicopter requires the minimum of fixed paraphernalia in proportion to its rate of doing work; and any comparison between the operating costs of fixed and rotating-wing aircraft which does not take these factors into consideration is quite unrealistic.

As a contrast to the enormous cost of aerodromes, B.E.A.'s new heliport at Nottingham cost only £2,000 to establish; yet it is capable of handling the largest twin-engined helicopters now envisaged. If only a fraction of the expenditure on airport construction in this country were to be devoted to the establishment of heliports, not only could a nation-wide network be set up in all our major towns and cities, but there would be money to spare to enable mail contracts to be awarded to potential helicopter operators to ease direct operating costs in the early stages of the inter-city operations. Another practical and most useful form of official support that could be afforded to helicopter operators, particularly to the independents, is the awarding of Civil Defence contracts.

Town Councils all over the country are only too anxious to co-operate. Many are showing their interest by associating themselves with the activities of the Aerodrome Owners' Association and the Helicopter Association. A number have advanced plans for the construction of heliports and only wait an inspired lead from the Ministry of Transport and Civil Aviation. Unfortunately, it has not been forthcoming.

To its credit, the M.T.C.A. has for many years given financial support to the activities of the B.E.A. Helicopter Unit. As a result, B.E.A. has acquired a wealth of operating experience which is unsurpassed in quality, if not in quantity, anywhere in the world. Nevertheless, if the Ministry were to devote its energies to creating the conditions in which the operators themselves could work to advantage, there would be no need for such support and no lack of eager potential operators. And, from a body of enthusiastic operators, both national and independent, the industry would receive the firm orders it needs to encourage it to press forward with development. Combined with the steadily increasing demand by the military services, such an incentive is exactly what the British helicopter industry needs today.

There are some who believe that the civil helicopter can only be used to economic advantage in the remote regions of the globe where other forms of transportation cannot be utilized. When Mr. Charles Forte (if he will forgive his activities being cited as an example) sought to establish his new chain of restaurants a few years ago, did he select the wilds of Yorkshire or Dartmoor as suitable locations to begin operations, on the grounds that there would be no competition in these areas? He did not. On the contrary he began in just those places which were already well served by J. Lyons and Co., Ltd., and other well-known catering establishments. *Certainly* the helicopter will always be in demand for rugged duties in the outposts of the world; but its greatest utility must surely be where the density of existing traffic is highest.

From the general tone of "How Fares the Helicopter?" one deduces that its author pins most of his faith in the future of the British helicopter movement on one machine, the Fairey Rotodyne, which has yet to be completed. This seems a little unfair to all the other constructors who have devoted so much effort to bringing the helicopter to its present stage of development. Lest there be any misunderstanding, the writer hastens to proclaim that, having had over three years' intimate association with the early Gyrodyne development, his own conviction that the Gyrodyne/Rotodyne configuration holds excellent promise for the future would be difficult to exceed. However, that is not to say that other configurations are not worthy of mention. When fitted with its more powerful engines, the tandem-rotor Bristol 173 helicopter would be a first-class machine with which to begin exploratory scheduled inter-city services. So would the Westland Wessex. Indeed, much essential route-development work could be done, either as an extension of B.E.A.'s present activities or by the independent helicopter operators, with the five- and eight-seater single-engined machines at present available in full production.

The remedy lies in the hands of the Treasury. All that is needed is an inspired lead.

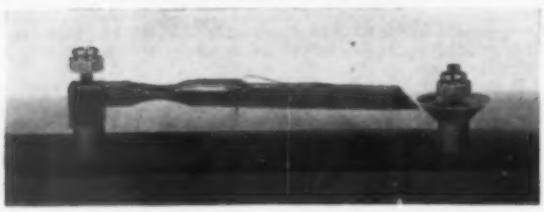
TENSION-LOAD LIMIT GAUGE

A SIMPLE but apparently effective device for gauging limiting-loads on aircraft structures in flight is shown in the accompanying illustration. Developed by the Aircraft Structures Group of the U.S. National Bureau of Standards, the method is applicable mainly to the tension surfaces of beams in bending.

The gauge is essentially simple, consisting of two principal parts for attachment to the member under investigation. One is a short post, rigidly bolted to the test surface and carrying at its upper end a horizontal arm, about 3in in length, made of 75S-T aluminium alloy and provided at its outer extremity with a hardened steel chisel-edged tip. This tip abuts on the hardened upper surface (and very near the outer edge) of what is known as the cam, which is comparable in shape to the head of a countersunk bolt. This cam is adjustable for height by rotation on a threaded stud, and can be locked in any desired position by means of a nut.

In use, the gauge is so adjusted that the tip of the arm bears firmly on the upper face of the cam. Thus, if an excessive bending stress, in tension, occurs in the material to which the gauge is attached, the tip will spring downwards over the edge of the cam.

The gauge is extremely simple in conception.



The cam face is divided into 20 sectors, each indicating approximately 2,500 lb/sq in (for Type B gauges) or 5,000 lb/sq in (Type A gauges) when used on aluminium alloy structures. These divisions give a linear relationship between lateral displacement of the cam and cam divisions.

The zero setting is found by placing the arm tip on the cam and rotating the latter until the arm springs downward. The tip is then set to overlap the cam by a predetermined distance equivalent to the desired stress. The required setting of the overlap can be determined from a calibration curve of the gauge, Young's Modulus of the structural material, and the stress level at which indication is desired.

Since any appreciable wear of the cam or arm tip might be expected to cause changes in zero setting and in the calibration curve, several wear tests were performed when the gauge was being developed. The gauge was mounted on a specimen suitable for use in an Avery fatigue-testing machine and subjected to a pulsating load a little lower than the value required for the gauge to indicate. After 30,000 cycles, the tip and cam were examined for wear and the cam calibration curve checked. There was little or no wear and the calibration remained the same.

To determine the accuracy to which the gauge could be set by different operators, a set of stress values and a calibration curve were given each operator who, in turn, set the gauge. The load at which the gauge indicated was determined by applying a tensile load to a test bar to which the gauge was attached. After several trials, an operator totally unfamiliar with the gauge could set it to a given value within 500 lb/sq in.

The load gauges have been flight-tested on both piston-engined and jet fighter aircraft. They were mounted at three positions on the wing and wire straining-gauges were arranged in close proximity to them. Following simulated dive bombing and other manœuvres the recorded outputs of the strain-gauges were compared with the values provided by the limit load gauges and found to agree within 10 per cent.

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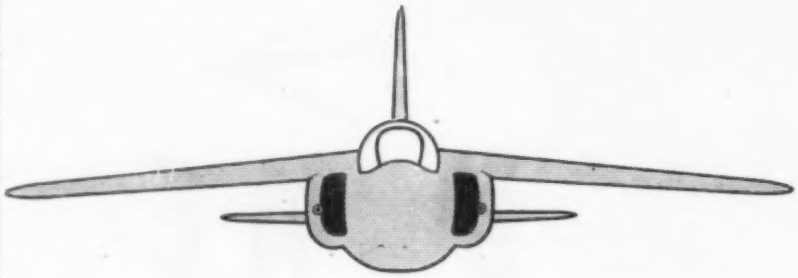

Now FINLAND ORDERS THE GNAT

THE GOVERNMENT OF FINLAND, LIKE THAT OF INDIA, HAVE CHOSEN THE GNAT FOR THE RE-EQUIPMENT OF THEIR COUNTRY'S AIR FORCE.

This light jet fighter — half the size, a third of the weight and needing less than half the thrust of the conventional fighter — makes big savings in initial and operating costs yet matches the conventional fighter in the nature and duty of its essential equipment and in flying and fighting performance. In some respects — e.g., in rate of climb, manœuvrability and maintenance — it has conspicuous advantages.

FOLLAND *Designed and Built by the Pioneers of the Light Jet Fighter*

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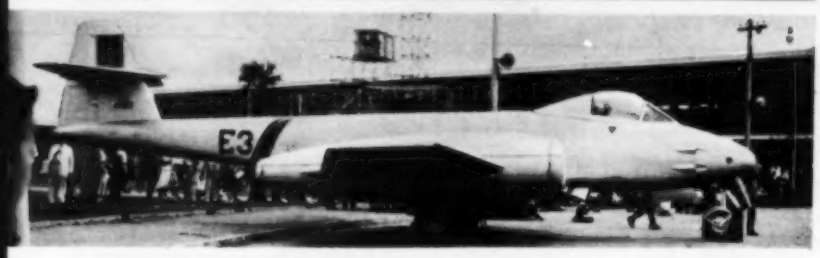


The Avro Shackleton M.R.2 with the extended "sting" tail is the subject of a paragraph on this page. The Gloster Meteor F.8 belongs to the Brazilian Air Force. The picture was taken at São Paulo by a "Flight" reader standing in the shade of a Republic Thunderbolt, with a weatherbeaten B-25 alongside.

AIRCRAFT INTELLIGENCE

Great Britain

Avro Shackleton M.R.2. A photograph above shows a Shackleton M.R.2 of the School of Maritime Reconnaissance with an extended "sting" tail, similar to that of the Lockheed P2V-7 Neptune. This machine is finished in the new Coastal Command colour scheme and the sting—doubtless containing magnetic airborne detection gear, as in the Neptune—is marked with white stripes. The photograph was taken at St. Mawgan.

U.S.A.

Beech L-23 Twin Bonanza. The U.S. Army and Beech Aircraft are negotiating a modernization programme for L-23 liaison aircraft. It is proposed to fit three-bladed propellers, supercharged Lycoming engines, oxygen and additional navigational equipment.

Beech T-34 Mentor. A contract expected to be signed this month will provide for the construction of about 90 Beech Mentor trainers in the Argentine. An additional ten aircraft—90 per cent complete—will be delivered early next year.

Bell XV-3. It is learned that one of the two prototypes of this convertiplane crashed late last month. Tests had proceeded "without incident" since April 1955.

Doman YH-31. The possibility of a French Government order for 50 of these helicopters is reported. Recent tests by the U.S. Army have shown that little more than one hour of ground work is required for each hour of flight.

Douglas B-66 Destroyer. It is officially confirmed that flight-refuelling capabilities are built into the B-66B and RB-66B versions of the Destroyer, and into the RB-66C (special reconnaissance) model. On a recent B-66 flight from Travis A.F.B., California, to Hickam A.F.B., Honolulu, the aircraft was refuelled about 900 miles out from the California coast.

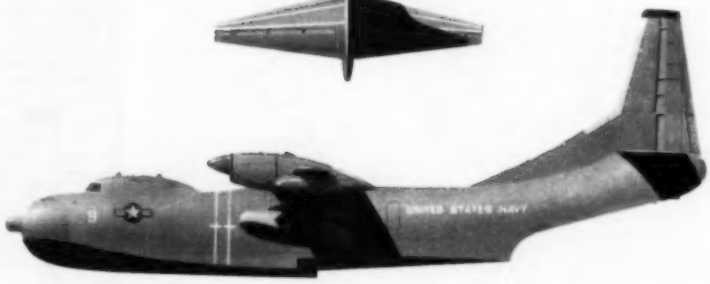
Martin P6M SeaMaster. Investigations by the Martin company and the U.S. Navy have produced no positive evidence as to the precise cause of the SeaMaster crash eleven months ago. *Aviation Week* reports: "Failure of the first SeaMaster's control system allowed the horizontal tail to turn full up suddenly, throwing the jet seaplane into such a severe downward turn that the engines ripped out and went straight ahead. The heavy negative force of —9g—imposed upon the wings as the aircraft suddenly lost speed and the wings turned almost perpendicular to the airstream—wrapped the wings around the fuselage.

Navy spokesmen said the wings clapped together beneath the fuselage, and the wing tips then flapped back outwards with a positive g force. Bits of wing were found imbedded in the fuselage and parts of each wing also were found imbedded in the other, Navy said."

Republic F-105 Thunderchief. Though six prototypes of this supersonic fighter/bomber are already flying, no photographs have yet been approved for release by the U.S.A.F.

CONVAIR R3Y-2 TRADEWIND
(Four Allison T40-A-10)

Span 145ft
Length ... ... 135ft 9in (approx.)



THE Tu-104 FLIGHT DECK

Impressions of a British Airline Crew

WHEN, as related below, the Tu-104 made its recent proving flight to Rangoon an English aircrew was invited to inspect her. In these notes one of its members records the pooled impressions of the group; he remarks that, in view of language difficulties and the comparative brevity of the inspection, "errors and omissions excepted" should be emphasized.

AT Rangoon one hot afternoon last month the unusual sight of an Aeroflot Tu-104 (L-5415) parked next to a British airliner could have been seen; and had the casual observer lingered a while, he would have seen the even more surprising sight of an English crew emerging from the Russian aircraft. Whilst they had been standing in a group beside their aircraft a message had arrived from the Russian crew inviting them to inspect the Tu-104. Needless to say the invitation was unhesitatingly accepted. The following description of the flight deck has been compiled from the impressions of the four officers.

The Russian crew-members (unfortunately neither of the two pilots was present) were very friendly and obviously proud of their aircraft. The time available for questions was limited and, owing to the difficulties of translation, some false impressions may possibly have been acquired. Also, since none of the English officers have any knowledge of the Russian language, instrument lettering and so forth meant little to them, although much could be deduced by visual inspection.

General Arrangement. The operational crew of the Tu-104 consists of four: pilot, co-pilot, navigator and radio officer. It was gathered that an engineer is also carried, but there is apparently no station for him, and certainly no panel. The pilots sit side by side, of course, but there is access between them to the nose of the aircraft, which houses the navigator's station, as in many last-war bombers. The radio position is behind the co-pilot, facing aft. A ladder gives access to the crew compartment from beneath. One has an impression of mainly metal and wood fittings; plastics are very little in evidence.

Performance. It was gathered that the all-up weight is of the order of 156,000 lb, and the tankage about 7,750 Imperial gallons. Cruising speed was quoted as 433 kt (800 km/hr), and a range of 1,950 n.m. (3,600 kms) was also mentioned.

Pressurization was given as 6.6 lb/sq in (.45 atmospheres) at 35,000ft, giving a cabin altitude of 10,000ft. One very interesting point about the pressurization is that there is an airtight door aft of the flight deck, giving an airtight bulkhead between flight deck and passenger cabin.

Engines, Controls, Instrumentation. The turbojets are of the axial-flow type each developing a thrust of 19,800 lb (9,000 kg). Duplicate throttle controls are provided for the pilots, to the left and to the right of the captain and co-pilot respectively. The fuel system was said to be automatic, but there appeared to be a control panel for it with a number of switches. De-icing is thermal. Engine-starting current appeared to be remarkably low—only about 135 amp [if this was indeed so it suggests two-spool engines.—Ed.].

The flying controls—unboosted—are conventional, with a direct link between control and control surface, and there is a normal type of gust-lock. It was mentioned that the rudder was rather heavy (presumably at low speeds). Trimmers and brakes are of normal pattern.

The autopilot control panel resembles that of the Minneapolis-Honeywell equipment; and a miniature joystick, mounted adjacent to the captain's right hand, appears to govern altitude and direction.

There is no basic blind-flying panel, instrumentation appearing somewhat haphazard to Western eyes. Most of the instruments are conventional, but are naturally calibrated metrically. The directional gyro is large and is calibrated to one degree. I.L.S. is fitted.

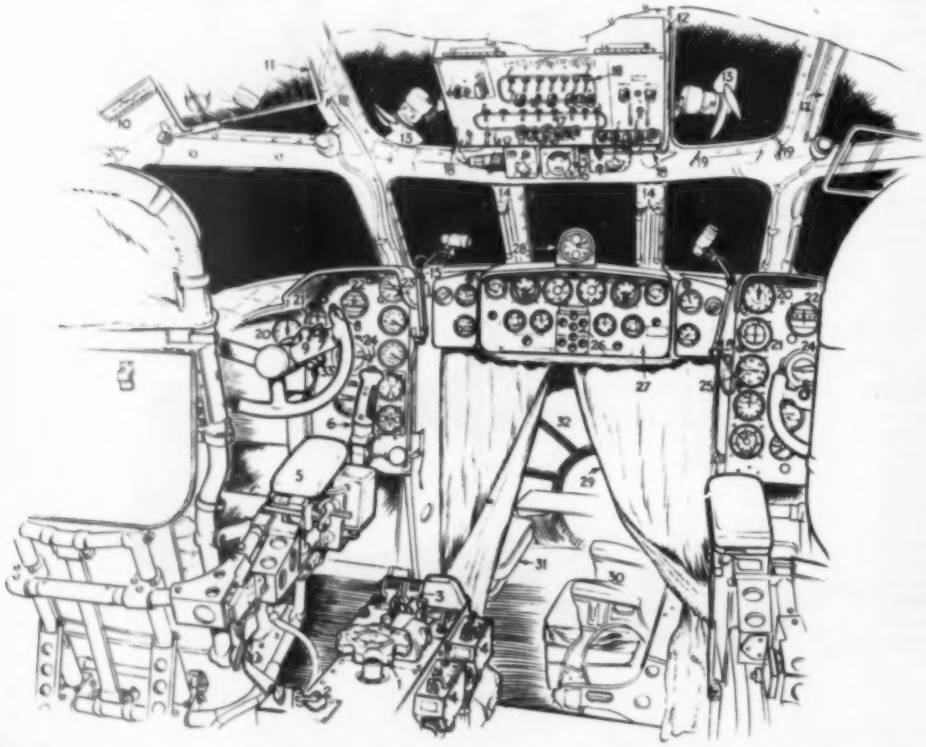
Pilot's forward visibility appeared to be good, despite the heavily raked windshield. The down position of the nosewheel can be observed through a window.

Communications Equipment. There seemed to be only one main transmitter, similar to a Bendix model of vintage 1943 or thereabouts, and one main H.F./M.F. receiver, strongly resembling the American "liaison" type. A second receiver of the same type, situated in the galley, is connected to the public-address system; it could probably be removed and utilized in case of a failure of the main receiver.

The V.H.F. appeared to consist of two very old sets, with only four press-button frequency selectors, rather like the R.A.F. TR.1196. The Russian radio officer, when shown a British radio rack, asked if we ever had to change crystals, so it seems a reasonable deduction that it is necessary to do so on the Tu-104. None of the radio equipment aboard is miniaturized. The external finish is good and the markings clear.

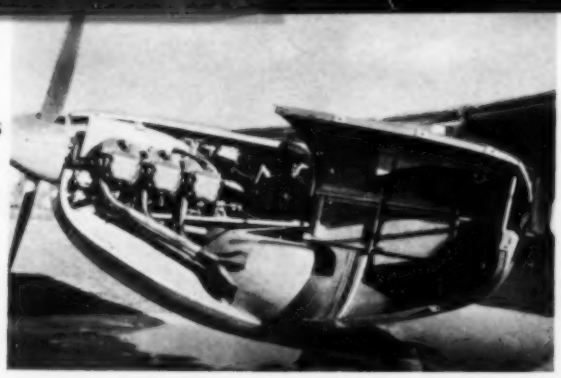
Navigational Equipment. The navigator sits at a small chart-table facing port with a comprehensive array of instruments in front of him. The large transparent nose gives him about the best view of anyone on the aircraft. At the navigator's position are two A.D.F.s (almost identical with the Bendix type used on the Constellation) mounted side by side; they can also be operated from the pilots' position, but not from the radio officer's. Two dials are mounted on the pilots' instrument panel—a good feature—but at the navigator's position is one dial with two pointers.

(*Continued at foot of col. 2, opposite page*)



1 Rudder trim
2 Windscreen de-icing pump
3 H.F. or A.D.F. controller
4 Duplicated four-channel V.H.F.
5 Adjustable arm-rests
6 Autopilot control hand-grip
7 Autopilot disengage
8 Press-to-speak
9 Elevator trim switch
10 One of six deviation cards for compass and A.D.F.
11 Sun vizor
12 Roller blind
13 Rubber-bladed fans
14 Desiccant capsule for sandwich screen panels.
15 At least six warder lamps
16 Gyro-magnetic compass master
17 Fuel panel lights
18 Head-guards around switches and lights
19 Demisting air outlets
20 Altimeter
21 I.L.S.
22 Direction indicator
23 Gyrosyn repeater
24 Artificial horizons
25 Vertical speed indicator
26 Undercarriage indicator lights
27 Engine instrument panel
28 Elapsed-time clock
29 Curtain
30 Navigator's adjustable seat
31 Navigator's table
32 Transparent nose panels
33 Instrument light (on control column).

This "Flight" drawing of the Tu-104 cockpit illustrates a number of the details observed by the author of the notes above. A few of them are conjectural.



The second prototype of the Spanish A.I.S.A. AVD-12C is powered by a Continental O-470-A 225 h.p. engine. Among many noteworthy features are the exhaust system entraining cooling air through a narrow passage at the rear of the engine cowling (above left).

Emile Dewoitine's Latest

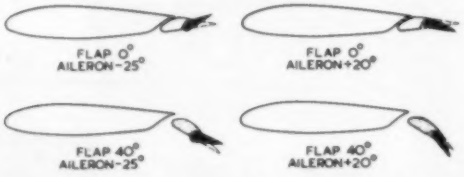
The Spanish A.I.S.A. AVD-12C

THE AVD-12C is the second prototype of the first all-metal design by the Spanish A.I.S.A. company (Aeronautica Industrial S.A.). When the decision was made to change to metal construction, Emile Dewoitine, the famous French designer, was engaged by the Spanish company, and the construction of the AVD-12 is based on the Dewoitine patented monospar principle.

The aircraft was designed to a Spanish Government specification for a light liaison type, and first flew over a year ago, powered by the 150 h.p. E.N.M.A.S.A. Tigre G-IV-B. Another aircraft built to this specification was the Dornier Do 25, produced by C.A.S.A.; this, too, had the Tigre. Both machines proved to be underpowered and the Dornier aircraft is now flying with a 270 h.p. Lycoming engine.

The second prototype of the AVD-12, designated AVD-12C, was completed earlier this year and is now undergoing flight test. It is powered by the same type of Continental engine as the American Cessna 180, but the company claims that either Lycoming or Continental units of between 190 and 275 h.p. would be suitable. The mountings for these units are interchangeable and only cowling panels would have to be modified for the fitting of a different type of engine.

The 12C's cabin will accommodate four people, and there is room for baggage aft of the seats. Fuel carried allows an endurance of about four hours or a range of 620 miles. Some of the military uses suggested for the aircraft include liaison work, light transport duties, artillery spotting, cable laying, aerial photography and ambulance work. For civil use the AVD-12C is claimed to be suitable for agricultural work; business and charter flying; mail carriage, including the picking-up of sacks without landing; and glider or advertisement-banner towing.

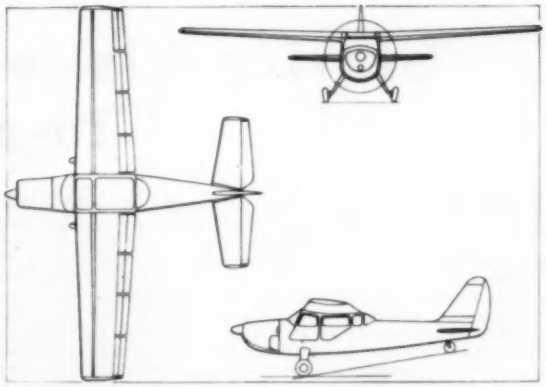


The full-span ailerons are hinged on the trailing edge of the full-span flaps and droop with them as shown above. The surfaces are mounted in eight sections to allow for bending of the unbraced wings.

A high-lift system based on the use of combined flap and ailerons is employed; the ailerons are, in fact, hinged trailing edges to the full-span flaps, both surfaces being slotted. The range of movement of the ailerons, from −25 deg to +20 deg, is measured relative to the flaps and not to the wing (as the diagram shows). The variable-incidence tailplane is connected with the flaps to cancel-out trim changes caused by flap extension.

Engine cooling is controlled directly in relation to power setting by an exhaust-pipe augmenter system incorporated in the cowling-panel layout. Large sections of the engine cowling are hinged for ease of inspection. The faired, single-strut undercarriage legs are pivoted at the point of entry into the fuselage and oleo-pneumatic shock-absorbers are mounted at their inboard ends, under the cockpit floor; dust is thus largely prevented from attacking the shock-absorbers themselves. Main-wheel brakes, based on or actually employing motor-car units, are hydraulically operated and differentially controlled.

For access to the cabin there is a large door, hinged at its forward edge, beside each front seat. In addition, there is a further hinged door aft, to port, while a fourth door aft to starboard hinges on its upper edge to lie flat against the underside of the wing. The main door-post at this point can also be readily detached and swung up with the door to allow unobstructed loading of a stretcher. For ambulance work a single stretcher can be carried to starboard, in addition to pilot and attendant.



Comparative data on the A.I.S.A. AVD-12C and the Cessna 180. Both are powered by the Continental O-470-A 225 h.p. engine:—

	Cessna 180	AVD-12C
Span	36.0ft	36.2ft
Length	26.2ft	25.4ft
Height	7.5ft	6.9ft
Weight empty	1,480 lb	1,668 lb
Weight loaded	2,550 lb	2,718 lb
Wing loading	14.6 lb/sq ft	14 lb/sq ft
Power loading	11.3 lb/h.p.	12 lb/h.p.
Max. speed	165 m.p.h.	173 m.p.h.
Cruising speed	150 m.p.h.	166 m.p.h.
Initial rate of climb	1,150ft/min	1,180ft/min
,, (with 2,320 lb)	—	1,510ft/min
Service ceiling	19,800ft	21,000ft
Endurance (cruising)	4 hr 30 min	4 hr 10 min

THE Tu-104 FLIGHT DECK

(*continued from opposite page*)

A Loran receiver of the older (World War Two) type is fitted, and there is some form of 6in search radar, which pivots on a vertical strut to the navigator's right and which probably connects with the scanner immediately below it. The bulge made by the scanner can be seen from outside the aircraft.

No magnetic compass of the "P" type was noticed, but there are two compass systems. One seems to be of the "flux-gate" variety with two scales visible, which were taken to be the uncorrected scale and a variation scale. The other compass system might be anything, possibly a magasyn. The usual A.S.I. and altimeter were fitted and there was, it is believed, a Mach-meter. No sextant or sextant mounting was observed, but this might have been overlooked.

Lastly, there was a complicated drift-sight rather like the stabilized automatic bomb-sight of the last war, presumably to measure ground speed as well as drift.

Summing up, the overall impression gained was that here was an adequate, fully equipped aircraft, though not an outstanding one by Western standards. In particular, it looked as though the Soviet radio industry is some way behind that of the West.

The visitors: (left to right) Ldg. Teleg. D. Dodds, P.O. Teleg. C. J. Byway, Chief Aircrewman S. W. Lock, Lt-Cdr. H. Cureton, R.N., Lt-Cdr. E. Dufall, R.N. (Senior Air Traffic Controller at Lee), Lt-Cdr. M. W. Rudorf, D.S.C., R.N. (No. 781 Sqn. Commanding Officer), Senr. Cmd. Plt. L. A. Cox, R.N., Lt.-Cdr. E. Waterhouse, R.N., Lt. G. Hunt, R.N., Lt-Cdr. (A) C. B. H. Barford, R.N.V.R.

Service Visitors to a Civil Airport

By C. B. H. BARFORD

IN a covering letter to the Editor, the author of this informal but informative account of a visit paid to London Airport by flying personnel from a Naval air station apologizes for what he calls the "sermon" in his concluding paragraphs; but with practical experience both as a B.E.A. pilot and an R.N.V.R. officer he is assuredly well qualified to discuss the conflicting Service and civil approaches to the subject of air traffic control. His plea for co-operation echoes our own ("Flight," October 12).

INTO the organized babel of the London Airways V.H.F. frequencies there has recently been creeping a new call-sign to vie with the Swissair and Bealines, the Rafairs and Panams, the Speedbirds, and even (occasionally) the Soviets. It is "Navair."

Ground users of R/T. must inevitably conjure for themselves a vision of the speaker at the outer end. A Speedbird, for instance, must surely be a man with iron-grey hair, gold rings up to his elbow, and eyes deeply crow's-footed from thirty years and 20,000 hours of peering into the wide blue yonder. But what does a Navair look like? Perhaps he is rather like a Speedbird, only with fewer rings, and with a large beard stuffed inside his oxygen mask. Does he request permission to "land-on" rather than merely to land? Is there salt caked in his eyebrows?

No, he really looks a very normal human being, as one of the accompanying photographs shows. It is a picture of some of the crews of No. 781 Naval Air Squadron, and their Commanding Officer, Lt-Cdr. M. W. Rudorf, D.S.C., R.N., is standing at the foot of the steps of one of his D.H. Sea Devons.

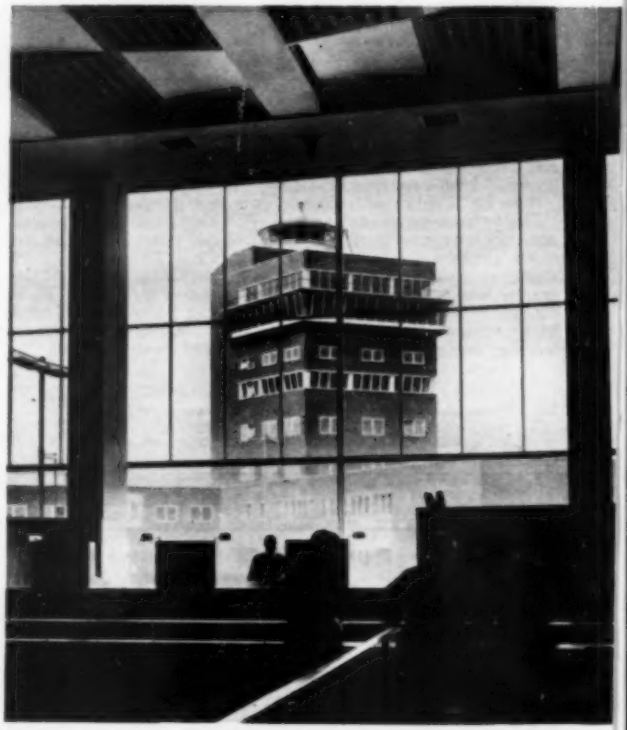
For some 15 years this squadron has acted as the communications unit of Royal Naval Air Station Lee-on-Solent, the headquarters of the Fleet Air Arm. It has been equipped with many and various aircraft, and today it is the proud guardian of the Navy's one remaining, and rather majestic, flyable Swordfish; but not until last year did it have any machines armed with all the radio gear necessary for airways flying.

The squadron's duties include regular flights between naval air stations as far apart as Culdrose, in Cornwall, and Lossiemouth on the Moray Firth; journeys to Northholt to pick up Very Important Naval Persons; and flights to several points on the Continent and Malta. With the increase in controlled air spaces in Europe the unit's usefulness has been more and more restricted, but the delivery last year of four Sea Devons, each equipped with two V.H.F. sets, a radio compass, I.L.S. and fan-marker receiver, has made it possible for them to fly safely and legally to any civilian and military airfield, no matter how exacting the control precedures may be.

In a quick look-round the cockpit of one of these Devons three things occur to the observer as possibly being worth altering to ease the task of the crew: the addition of a M.F. receiver, so they can listen to a radio range (or the Light Programme!) at the same time as having the radio compass tuned to something else; the installation of individual mixer-boxes so that each man can listen to any one or more radio facilities he wants without distracting his neighbour; and the use of a little yellow and blue paint on the face of the I.L.S. dial to assist in rapid orientation.

It is easy to build up empires. There be they who say that the ability of a pilot to fly airways and do what he is told in control zones is a special skill which not all pilots possess. This, of course, is nonsense. Any man capable of being a Service pilot can fly airways when he has a competent assistant—but it does take practice to do it without causing delays to other aircraft and bringing grey hairs to air traffic controllers.

The pilots and aircrewmen of 781 have acquired this practice; and, just to complete their familiarity with the control system, it was thought a good idea that they should fly into London Airport to see how the people work "on the other end." So, an approach was made to Mr. W. Woodruff, Air Traffic Controller-in-Charge at L.A.P. He responded most cordially, with the result that soon after 1 p.m. on September 28 a Devon calling itself Navair 744 left Lee-on-Solent, flown by Lt-Cdr. Rudorf, and carrying four pilots, three aircrewmen, Lee's Senior Air Traffic Control Officer, and the writer.



Back-tracking a little, so as to insert herself into the airways system, 744 flew north-west to the M.W.E. beacon on Southampton Water. She was then fairly in the groove of Airway Red 1 at 5,000ft and with a 50-knot wind behind her. With a slight holding at the Dunsfold Range, and a radar-guided descent from Epsom Range, 744 was soon down-wind for Runway 23 Left in such good visibility that there was an excellent chance of looking at the general layout of London Airport.

To the visiting pilot the lanes of intersecting concrete are rather confusing; but after landing the Devon eventually found

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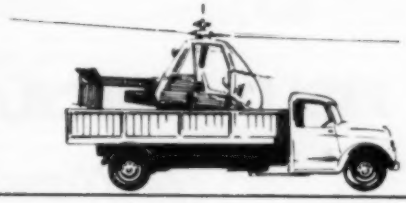

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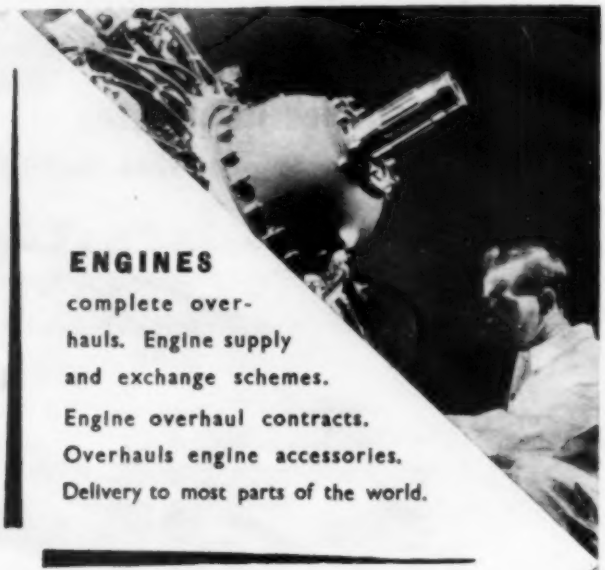

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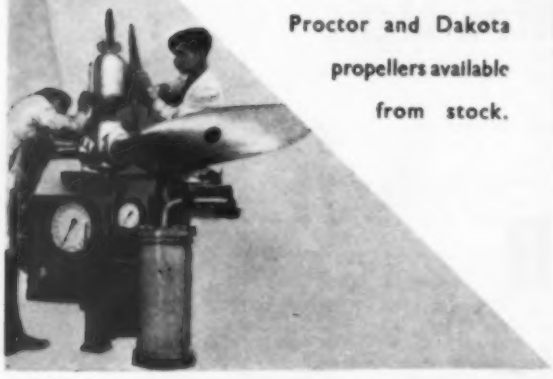

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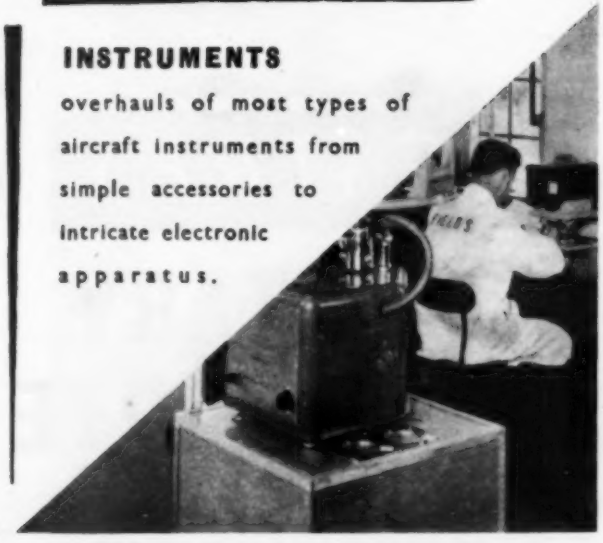

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SERVICE VISITORS . . .

her way to the south-west parking space in the Central Area where, in recent months, Tu-104s have sometimes been seen standing. This time there was a Britannia, just about to start on a demonstration flight, which served to make the Devon look quite tiny.

Mr. Woodruff met the party at the door of London's 130-ft tower and whisked them up in the lift to the sixth floor, and then up two flights of stairs. Here was a steep ladder very much like those that lead up to the bridge of a ship, and at the top of it was the tower control-room itself. The nautical impression continued, for the room has some of the characteristics of a bridge itself. It is light and airy, the wide-sweeping view magnificent; there are some curious pieces of equipment, and half-a-dozen people stand or sit rather casually, not appearing to be doing anything very much. This is a complete illusion, of course, for when you listen to their radio and telephone conversations you realize how many functions these operators are combining: telephone touch with Approach Control, G.C.A., and Southern A.T.C.; talk with aircraft on Tower and Ground Control frequencies; reading of airways clearances to aircraft; control of ground movements of taxying and towed aircraft and of airport maintenance vans; interpreting and acting on messages received by ticker-tape; and managing the daylight markers (electric signposts which are switched on to guide pilots through the concrete maze). There is an elaborate console stretching a quarter of the way round the sixteen-sided, glass-walled room, and at night it is a full-time job for one man to operate this, switching the system of green centre-line taxi-way lights and red stop-bars. It was comforting to learn that if the switchgear of the red lights should go wrong it will "fail-safe," and so prevent a pilot taxying on to a live runway. Best of all in the tower was the large-scale radar screen covering the airport, on which we could see aircraft moving round to the take-off point, and almost pick out "The Coach and Horses" at Harlington Corner!

The approach-control room, two stories down, was in contrast. Heavily curtained, lit by only small desk lamps, and very quiet, it was almost like a chapel. There was an air of quiet concentration about the six figures who sat at desks, writing, telephoning and talking on the radio. Two of them worked at large radar tubes, and it was fascinating to watch the blips (each with its fading tail making it look rather like a fluorescent tadpole) being picked off the Epsom and Watford holding stacks. The blips were given courses to steer so that each would be on final approach behind the other at a decent interval.

Although on this day the visibility below 3,000ft was perfect, the monitoring was clearly a much more certain way of ensuring a rapid landing sequence than asking pilots to position themselves behind one another. Not only does London Approach look after its own aircraft, but it also has to control those going in to Croydon, Bovingdon, Northolt and Hendon.

The dedicated atmosphere of the approach room was broken by the arrival of a neat and clean tea-wagon. The Ministry certainly know how to organize things, including an excellent cup of tea. Over it we talked with the supervisor, who has various administrative duties to perform, such as giving permits for grass-cutting work on the airfield. He said how much they were looking forward to the arrival (which was to end so tragically) of the Vulcan from Aden, because they welcomed the increasing use that Service aircraft were making of civil facilities. This was heartening to us, because there does exist among many Service pilots a feeling of not being wanted at civil fields.

Mr. Woodruff had laid-on one of those bright yellow Ministry coaches to take us through the tunnel from the Central Area and out to the Southern Air Traffic Control Centre a few hundred yards along the Bath Road. Control towers and approach rooms, of a kind, were all within our previous experience, but the Centre was to be something quite new to us. One member of the party said afterwards that his first impression on entering the large control room was of a gambling den. The daylight is curtained off, and this makes the room stuffy; the lights are dim, and men and women sit crouched at tables. There is a general murmur of voices, and above this a clicking just like chips being raked around on the green baize tables. Every now and then a voice could be heard clear above the others. "Rien ne va plus!", did it say? Or was it just broadcasting the area QNH for the next hour?

The supervisor here gave us a short talk on the general task of the Centre. In brief, they have to control the movements of hundreds of climbing, descending and cruising aeroplanes a day, keeping them separated from one another so as to avoid collision. This is complicated by the presence of machines of very varying type and speed, driven by crews of many nationalities. Their only medium for this, in the last analysis, is the human voice, and their success depends very much on the immediate response of pilots to requests and instructions.

In that statement is distilled the essence of a 1,000-page dissertation, so it is not surprising that in the hour spent there we could not compass all the functions that go on within the Centre and in its contacts with the outside. These contacts are by telephone to numerous airfields in the south of the British Isles, to Belgian and French Centres, to Britain's Northern Centre, to the Channel Isles, Ireland and other overseas centres, to R.A.F. radar stations, and the area W/T. and H.F. R/T. centres.

"There is an elaborate console stretching a quarter of the way round the sixteen-sided, glass-walled room."

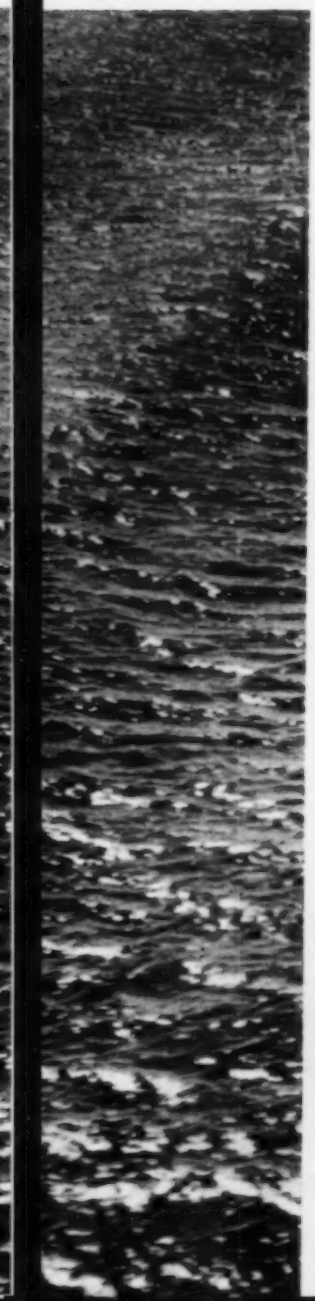
What we did was to go round individually and see what went on at the various desks. With loaned earphones, for instance, you could plug in to a console and see and hear aircraft Juliet Victor's clearance to Nice being worked out; swiftly unplug, and across the aisle hear London Ground Control reading it out to her; unplug again when she had got take-off clearance, and blunder through the half-light of the control room to listen to the sector radar controller who was watching her departure towards Chertsey and Dunsfold. The tadpole on the screen was easy to pick out; and when another, unidentified, one emerged on the screen the controller gave JV a course alteration to remove all risk of collision. And all the time the rattling and clicking went on, as controllers and their assistants sorted the metal holders for the strips of paper on which the details of all aircraft are recorded.

An hour later, after a quick tour through the shiny passages of the Queen's Building in the Central Area to see the new briefing room, and after a visit to the strangely-named "waving base" on the main passenger building, the party was ready to take off for Lee. As Navair 744 climbed away, and one heard the radar controller's voice giving clearance to go up to 4,000ft over Dunsfold, it made for a sense of confidence and security to imagine oneself as a tadpole on the tube in front of the man with whom one had been sitting and talking so short a while ago.

Various general impressions of the visit remained. For example, no wonder airways people may not undertake to give an aircraft clearance into a controlled air space unless they have a good twenty minutes' notice; it is remarkable that they can fit them into the pattern at all! Controllers may not be shiny-domed scientists, but they have a most exacting job; and one can understand if, occasionally, they do not reply for a few seconds to an R/T. call. Although co-ordination between Service and civil A.T.C. in some cases is very close (Biggin Hill, for instance, were keeping Southern Centre informed minute by minute of all their jet movements), there is still a large cleavage of opinion between Service and civil authorities. As an example, the lower limit of some airways is 2,500ft, but the Services do not recognize any below 5,000ft. Are we to wait until someone is killed in a collision before this is remedied? There exists a curious idea (though not among 781 Squadron) that there should be one law for the Service and another for civil operators; but those who hold this view forget that there is only one piece of air-space above the British Isles, and a very heavily loaded piece at that. The difficulties of obtaining a co-ordinated system of control have often been aired, and they are very great; but it would be a big step if we could all adopt a mental attitude symbolized by the word "co-ordination," and not think in terms of one authority trying to over-ride the other.

Members of the Guild of Air Traffic Control Officers, who expressed themselves so emphatically at Southend recently on the problems of control in this country, may be assured that there is at least one group of Service personnel who are a good deal wiser and more sympathetic about those problems than they used to be.

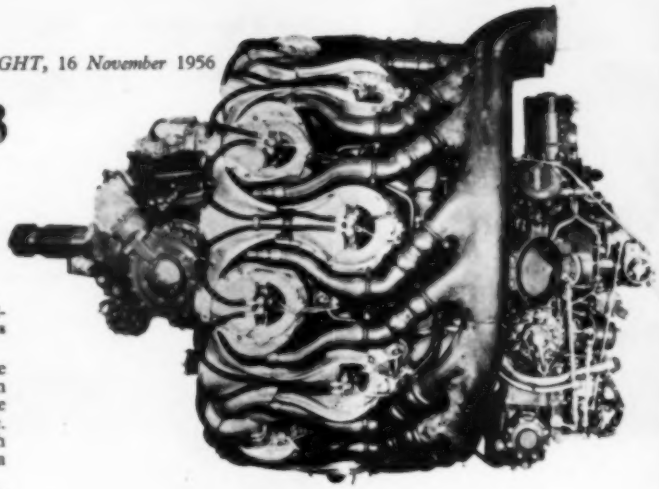
D.H.110—A NEW DESTROYER FOR THE NA



OF the two prototypes of the D.H.110 carrier-borne all-weather fighter, one—XF828—is at present distinguished by a rounded radar nose. It is this machine which is seen on the left leaving the starboard steam catapult of H.M.S. *Ark Royal* during recent operational trials. This, too, is the subject of the air-to-air view above, and of the detail photograph at centre left, showing the metal strakes which run fore and aft along the edge of the air brake with the object of increasing effectiveness. As now in production for the Fleet Air Arm at Christchurch, the 110 will have a pointed nose, seen on prototype WG240, depicted at top left. WG240 is operating from Hatfield, whereas XF828 is based at Christchurch. A heavy armament of missiles is intended.

CENTAURUS 373

Direct-injection Engines for the Beverley



FOR nearly 40 years "Flight" has periodically published articles recording the progress of new Bristol reciprocating aero engines. What follows may, perhaps, be the last.

SINCE the 1920s the engine division of the Bristol Aeroplane Company (now Bristol Aero-Engines, Ltd.) have been steadily developing air-cooled radials incorporating a valve system using a single sleeve of the basic Burt-McCollum type. The last and greatest of these engines is the Centaurus, which was coming into production at the end of World War 2 with a rating of 2,000 to 2,200 h.p.

Owing to the exigencies of the war, early production engines employed the American Bendix carburettor. However, all the post-war series of engines used the Hobson/R.A.E. pattern, which meters the fuel according to the demands of the engine and injects it through orifices in the intake manifold. This system is employed in all Centaurus engines currently in use. Nevertheless, advantages can be gained by employing direct injection of fuel into the cylinder heads, and Bristol began to study a direct-injection Centaurus as long ago as 1945. Between that year and 1952 over 1,300 bench-hours were run at powers up to 3,400 b.h.p. on modified Centaurus 57s fitted for injection into the cylinders from nozzles in the induction pipes. Such an engine was first run in 1947 and a pair were flown in a Brigand test bed in 1949.

By 1952 the D.P.I. (direct petrol-injection) Centaurus had ceased to be an active project, but events elsewhere were taking place which have now re-activated the programme. These developments concerned the Blackburn Beverley heavy military transport.

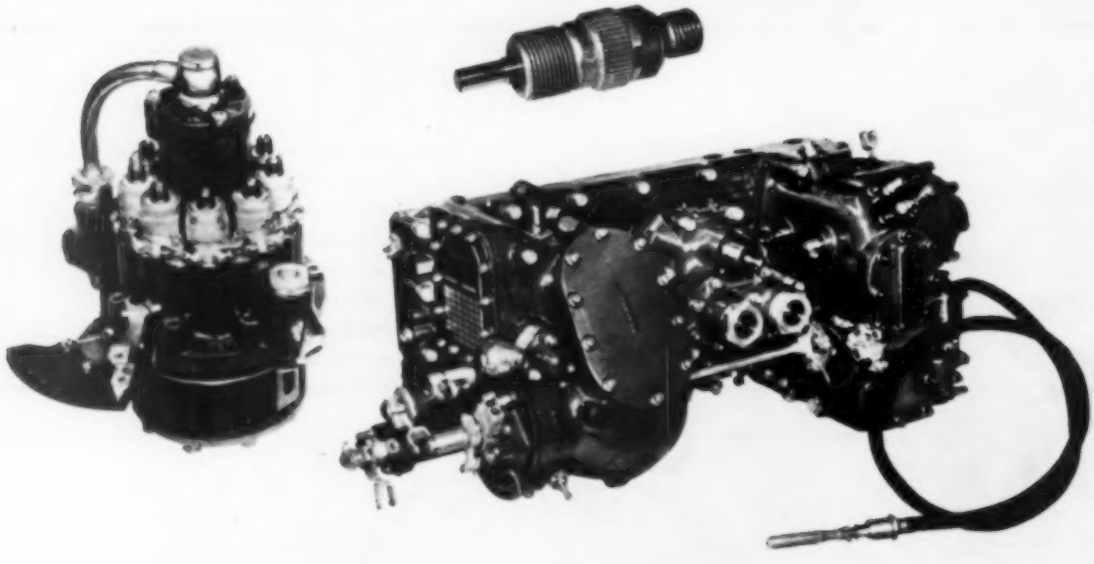
The original General Aircraft G.A.L. 60 design (forerunner of that aircraft) was based on four Bristol Hercules 261s driving propellers of 14ft diameter. By the time that Blackburn and General Aircraft, Ltd., was established as a single firm in 1949 it was appreciated that the design could be greatly improved by employing Centaurus engines and larger propellers. Unfortunately, money was tight at that time and development was able to proceed only by using an engine very similar to the Centaurus 661 of the B.E.A. *Elizabethan* class. This necessitated some compromise, but Blackburn and Bristol were able to evolve the Centaurus 160 series with a single-speed supercharger and methanol/water injection to give a maximum take-off rating of 2,850 h.p. Centaurus 165s were fitted to the second prototype, although retention of the original wing prohibited any increase in propeller diameter. After flying for many months, the aircraft was fitted with a completely new wing and re-spaced engines of the type now standard on the production Beverley. This permitted installation of the slightly modified Centaurus 173 driving de Havilland hollow-steel-blade propellers of 16ft 6in diameter, the largest used in Britain.

Nevertheless, it could still be shown that the Beverley would be further improved by even more powerful engines. Blackburn wanted to be sure that power would be available to keep pace with the maximum possible development of the aircraft, and lengthy talks took place with a view to determining how further increases in power could best be provided. In the early part of 1954 the Bristol Aeroplane Company put forward a proposal for two further stages of development of the basic Centaurus 173: a D.P.I. Centaurus rated at 3,150 b.h.p. and a Turbo Centaurus of 3,600 b.h.p. After discussions with the Ministry of Supply it was decided to proceed with the first stage of this programme, and the D.P.I. Centaurus project accordingly became active once more. It was expected that the lengthy background of direct-injection experience already gained at Bristol would hasten development, and this has proved to be the case. The first Centaurus 373 was run on the test bed in July last year; considerable development time has now been recorded and flight trials are about to begin.

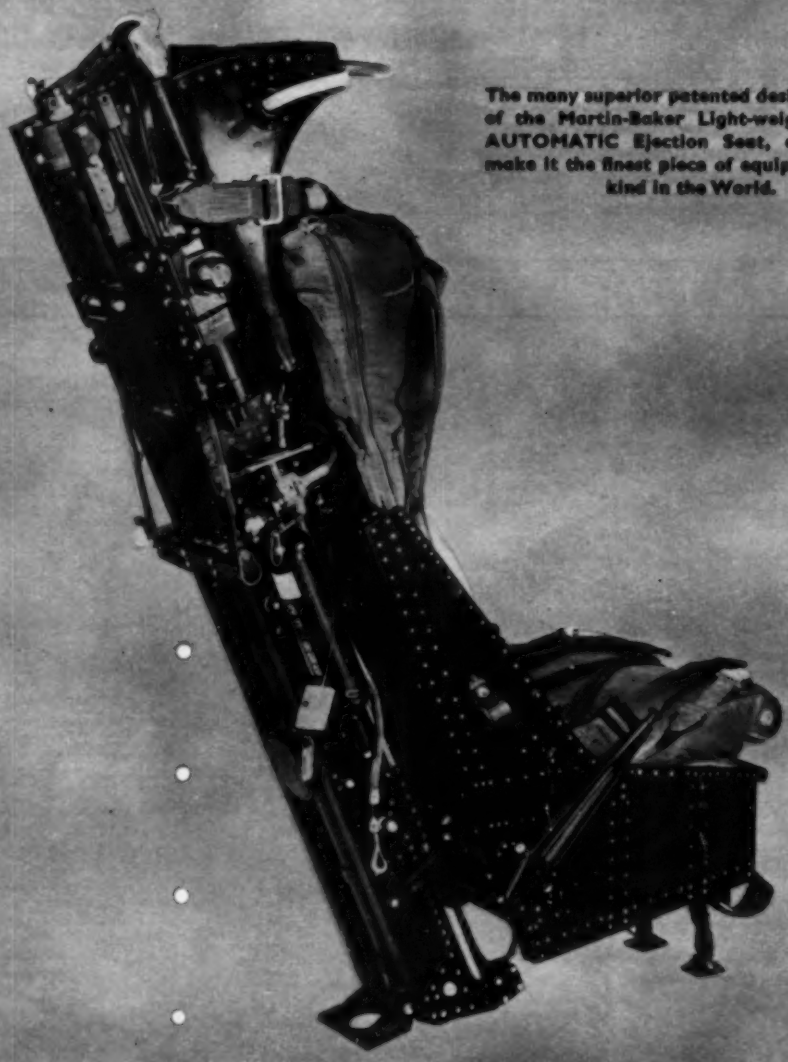
During the first programme of D.P.I. development, fuel was supplied to the induction belt around each cylinder and injected through ports in the sleeves. Such an arrangement overcame the difficulty of accommodating the injection nozzle in the already fairly crowded cylinder-head. In the 373, however, it was decided that cylinder-head injection was well worth while and this has, in fact, been achieved. Such an arrangement removes restrictions on spray angle and also permits an even radial spray over the entire combustion space. It also makes the injection system independent of valve timing, and the latter has been adjusted to provide greater overlap.

To a considerable degree the injection pumps resemble the familiar pattern long used on London buses and other commercial vehicles, the supplier being the same firm, C.A.V., Ltd., of London, W.3. The Centaurus 373 has two such pumps mounted one at each side of the supercharger casing. Each pump has nine plungers and feeds nine cylinders, the fuel delivery being regulated by a Hobson control unit. Generally similar to the present

Developed jointly by Hobson, C.A.V. and Bristol, these units are the chief additions to the Series 373 engine. The control unit is the largest item; the injection pump is on the left and a single injection nozzle is also visible.



used by air forces of twenty-seven nations



The many superior patented design features of the Martin-Baker Light-weight FULLY AUTOMATIC Ejection Seat, combine to make it the finest piece of equipment of its kind in the World.

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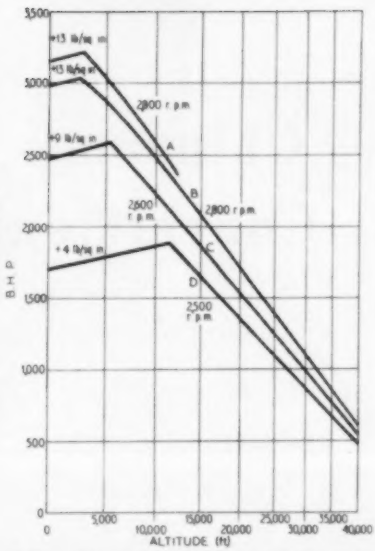
CENTAURUS 373 . . .

Hobson/R.A.E. system, this unit senses the boost, atmospheric pressure and exhaust back-pressure and charge temperature; but instead of altering the orifice through which the fuel passes (as it does in all present Centaurus engines), it varies the delivery of the plungers of the injection pump. Fuel is delivered direct to the cylinder heads through a total of over 100ft of high-pressure steel piping. The nozzles are of a Bristol design which has improved the behaviour at low r.p.m.; each nozzle lifts at about 650 lb/sq in, the peak delivery pressure being around 2,000 lb/sq in.

Flight trials of the Centaurus 373 are about to begin and, in view of the fact that the aircraft has now been granted full C. of A. clearance, the D.P.I. Centaurus could become the standard power-plant for the Beverley and the civil Universal.

The D.P.I. has been so engineered that it is quite practicable to convert existing Centaurus to 373 standard, and there is no reason why this should not be done during overhaul periods. To effect a conversion the chief requirements are the following: change to new cylinder heads incorporating injection nozzles; installation of the injection pumps to drives which already exist; modification to the Hobson control system; installation of fuel-delivery piping; and modification to the existing cylinder sleeves to conform to the revised valve timing. As far as the powerplant is concerned the only modifications necessary are: fitting of a new air intake and cleaner suitable for the larger air consumption of the engine; installation of a vent pipe between the injection pumps and the fuel tank; and modification to the cut-off control, fuel and oil pipes. No changes are anticipated to the propellers or ancillary equipment.

As the accompanying curves show, the D.P.I. engine will be able to deliver considerably more power than previous Centaurus marks. The cooling of the engine has also been improved to permit full use to be made of the increased power, and it will be possible to take higher powers on weak mixtures without detonation. The possibility of back-firing (never a failing of the Centaurus) does not exist, as there is no petrol-air mixture in the induction system. Further increases in take-off and climb ratings present little difficulty, but advancing the weak-mixture power would normally have necessitated fuel of a higher octane rating than the standard 100/130 grade. In order to provide more w.m. power on the same fuel further research is being carried out on a Centaurus 373 in which the compression ratio has been reduced from 7.2 to 6.75. This will permit a considerable increase in rating over that at present offered by the 373, at some expense in increased specific fuel consumption and head temperature.



Provisional power curves for the Centaurus 373 under i.s.a. conditions. The curves are: A, max. take-off and operational necessity with water/methanol; B, as above but without w/m. injection; C, max. continuous; and D, max. weak-mixture. The curves assume 100/130-grade fuel and a flight exhaust system, but without ram.

CANADIAN INDUSTRY PROGRESS

IN his presidential report at the recent annual general meeting of the Air Industries and Transport Association of Canada, Mr. E. H. Moncrieff said that the past year had probably been one of the best in the history of the Canadian aviation industry. For the air carriers it had been a year of unprecedented activity, while the industrial side of the industry continued to provide an essential link in the defensive strength of Canada.

Preliminary figures for 1955 showed the air carriers to have had an operating income of $6,162,483, compared with $1,876,920 in 1954. Bulk transportation services were almost trebled, largely as a result of DEWline and Mid-Canada-line airlift activity, and revenue freight lifted was more than double that for the previous year. Estimated figures for the first six months of 1956 showed that "tonnages carried by the carriers are up by 25 per cent over the same period last year and the number of passengers carried is up 33 per cent."

Mr. Moncrieff, A.I.T.A., President, 1955-56.

The tempo of the radar-chain operations was now gradually slowing down, Mr. Moncrieff stated. Transport of the largest proportion of materials and supplies for the construction of these projects had now been successfully completed and, in the near future, flying requirements would probably be reduced to the maintenance and supply of the various radar sites.

The level of activity of the manufacturing industry during 1956 had been governed largely by the fact that the initial build-up of the country's air defence programme had been completed. As a result there had been a shift in emphasis from manufacturing production to design and development of future equipment and the re-supply and maintenance of existing equipment. The acquisition of new research and design facilities had provided new techniques and skills and had created additional sources of supply.

Although total current expenditures for air defence remained at $872m, approximately the same level as last year, the current trend was indicated by the drop in appropriations for new aircraft and engines to $197m from the 1955-56 figure of $293m. From 1954 to 1955 the total employment in the aircraft and ancillary industry had remained at about the same level, and the total value of aeronautical production had increased from $346m to $353m. "Generally," Mr. Moncrieff said, "I would say the industry presents a fairly healthy picture at this time."

HELICOPTER DESIGN PROBLEMS

AS reported in last week's issue, a lecture on *Design Problems of a Large Helicopter* was given by Dr. G. S. Hislop (Fairey Aviation Company) to the London Airport branch of the Royal Aeronautical Society on October 30. Some 90 members were present.

Dr. Hislop began by emphasizing the tremendous undeveloped field for the use of large helicopters (over 20,000 lb gross weight) as short-range transports between city centres. To be successful in such operations, he said, the helicopter would need a cruising speed of some 150 m.p.h., a seating capacity of 40 to 50 persons, an operating cost less than 6d per seat mile and a safety standard equal to that of modern civil aeroplanes.

Turning to the problems encountered in the design of such a helicopter, the lecturer first mentioned that of obtaining a suitably low ratio of rotor-blade weight to aircraft weight. Blade weight was influenced by factors such as rotor diameter, tip-speed limitation, blade coning angle and shaft torque. The complete weight of the rotor system resulted from the structural requirement to transmit the power and to react the blade loads, plus the control-system requirement. The problem of designing to maintain constant blade angular-velocity under flight conditions with cyclic variation of airflow over the blades was next discussed.

Appreciable penalties in structural weight and power wastage were imposed in shaft-driven rotors by the power transmission shafting and the need for torque-reacting devices. Distinct advantages on these points were offered by the use of tip propulsion. The speaker went on to consider the relative merits of the four basic types of tip units; ramjet, pressure jet, pulsejet and rocket.

The forward speed of current types of helicopter was limited by factors directly associated with stalling of the retreating blade. This limitation, however, could be overcome with the help of conventional propellers and wing surfaces to unload the rotor in cruising flight. Boundary-layer control techniques could be applied, but it was too early to assess their overall economic merit.

Other design problems arose from the requirements of stability and of fatigue. The former, as affecting the fuselage as a whole, could be met largely by the application of conventional methods. To reduce overhaul costs, fatigue must be catered for by designing on fatigue criteria for the materials concerned, with due regard to the rôle of the various structural components. In this respect the helicopter designer was placed somewhere between the engine designer, who had always needed to design for fatigue conditions, and the airframe designer, who had in the past been primarily concerned with design on ultimate strength criteria.

In conclusion Dr. Hislop referred to operating costs as they affected the design of helicopters. A cost-range diagram indicated that, on a basis of seat-mile costs, the large helicopter would be cheaper than the best present-day conventional aircraft over stage lengths up to 150 miles.

Chipmunk Conversion

The Long, Long Road from R.A.F. to the Flying Clubs

By DAVID F. OGILVY

With the frustrations of "civilianizing" the Chipmunk behind him—it is to be hoped—the author, who is manager and chief flying instructor of the Elstree Flying Club, presents the attractive club newcomer aerobatically.

NOW appearing, or due to appear, in the aircraft fleets of various British Flying Clubs are numbers of ex-Service D.H. Chipmunk 10s, converted to civil Chipmunk 22 standard—ideal advanced machines, it is generally agreed, for instrument and aerobatic work with the clubs. Conversion, however, is neither a simple nor a logical process, as this article on Elstree Flying Club's experience indicates.

WHEN the R.A.F. Basic and Reserve Flying Schools came to grief in 1953 hundreds of de Havilland Chipmunks were flown to maintenance units; no productive use could be found for them. Some were absorbed into university air squadrons and communications flights, others were retained for squadron "hack" use, and a few were sold to civilian customers; but the vast majority were crowded into storage hangars at Cosford, Aston Down, Hullavington and Silloth. Now, at last, some have been released; and it is with these and other machines likely to be "demobbed" in the near future that this article is concerned. For these aircraft offer new—but belated—life for the clubs.

It sounded simple enough. A well-proved training aeroplane produced by one of the country's leading manufacturers should present no problems, and many people underwent rapid conversions from lethargy to excitement when the first public tender announced that about thirty Chipmunks were to be sold from Cosford. However, believe it or not, at that time no firm decision had been made and the type was not eligible even for consideration for the issue of a civil Certificate of Airworthiness!

Many people bought without thought and found themselves in trouble, for some few years ago new requirements were introduced to ban the conversion of Service aircraft for civil use: unless the specific type *and mark* had been approved for a C. of A., the machine was worth little more than scrap on the outside market. Many well-known and ultra-safe aeroplanes suffered as a direct result; and, although any individual specimen in possession of its civil certificate at the time of the rule-change could have its C. of A. renewed, no further specimens could be civilianized, even if brand-new. The Anson 1 is one such sufferer; its younger sister the Anson 19 is type-tested, but the basically similar marks 20 and 21 are not recognized!

And so with the Chipmunk: the hundreds built for the Services were produced as T.10s, while the handful assembled for civil customers were known as Mk 21s. Very few people could afford to buy new aeroplanes, and Air Service Training at Hamble, with four examples, are about the only genuine home users of the Mk 21. When the surplus military 10s were parked on the market, however, many of us hoped that at last our chance had arrived to re-equip the clubs and schools with something more complete and advanced than the Tigers, Austers and Magisters that otherwise would have to soldier themselves to eventual death.

But alas, the Chipmunk 10 is a Service aeroplane and therefore, it seems, dangerous. The fuel capacity of 18 gallons, giving a safe endurance of about 2¼ hours, was considered inadequate—yet is it as bad as that of the Lycoming-Auster, whose 15 gallons tend to give rise to fear of failure and forced-landing long before two hours have been flown? That boiled down the initial excuse to rather weak reasoning, so after hours of dispute and desk-hammering we were permitted to retain the pair of nine-gallon tanks—into which, incidentally, ten gallons can be poured quite easily.

That was one stumbling-block overcome, but not without a few trips and falls *en route*. However, that was only the start. The propeller—fully serviceable, of course—must come off and be sent away; and to get it back with the necessary tag of approval one must hand over a sum considerably in excess of twenty pounds. The instruments, too, must be pulled out to be overhauled and released; and with two complete blind-flying panels and a pair of compasses, as well as a number of ancillary dials, we find ourselves confronted with a three-figure bill before they can be re-installed.

How about the engine? Even our old friend the Gipsy Major 1, surely the most rugged and reliable little unit ever produced anywhere, now comes under fire and fear of suspicion. The high-compression Major 8 in the Chipmunk is viewed with such official apprehension that any surplus military specimen that has run for more than 500 hours of its 1,000-hour life must be thrown away or returned for reconditioning. An engine that has completed a figure under this artificially prescribed amount may be retained for use—subject to its being partially pulled down for examination by a representative of the makers—who, incidentally, is not permitted to accept responsibility for its re-assembly and final clearance. For this an independent D-licensed engineer must be called in. . . .

Despite all this we still have basically a Chipmunk 10—but this has never been approved as a civil aeroplane; so, in addition to hauling every hing apart and putting it all together again, we must take great care not to put back all the parts in their original homes. By so juggling with what is established and what has been proved safe through experience, we eventually convert our Mk 10 to a 22, the la ter a new number concocted for the purpose, enabling us to apply for a C. of A. But what of those parts that we must move? As an example, the hydraulic-fluid reservoir was originally mounted in a safe, easily accessible and easily checked position just inside the port cowling and on the forward face of the firewall, where it has functioned satisfactorily for thousands of airborne hours. Just to tempt fate and to ensure that any leak would have dangerous results rather than drip casually on to the bottom tray and thence to eternity, we must now position the tank immediately above the voltage regulator. Without this element of danger installed, we cannot so much as ask for a C. of A., and the aircraft's activities must apparently be restricted to the teaching of Service pupils (who have included, it may be remarked, the Duke of Edinburgh).

And so on. We could write page after page of the troubles, setbacks, delays and expenses of converting our first Chipmunk for use as an instructional aircraft, but at last we now have it in service and it is earning belated doses of fuel and oil and proving more than popular with all who fly it. Unfortunately, business is business and all the cost of conversion, maintenance and operation must be passed on to the user, so no club or school can hope to operate this most useful machine at Tiger or Maggie rates. By club standards, however, it is a special aeroplane and its value is wrapped up more in its potential as an advanced trainer for instrument flying, aerobatics and radio work than as a counterpart or replacement for the earlier types.

At present the Chipmunk cannot be considered a machine for large-scale civil use, but it does give a few of the larger clubs their first chance of partial re-equipment with an aeroplane of com-

"Flight" photographs

paratively modern design. It will, in fact, be the last military trainer suitable for reasonable economical operation. Some of the hundreds of R.A.F. and V.R. pilots who flew the type in earlier and happier times and who have since abandoned the art of aviation may now well be tempted back to the game. Those who so far have never experienced a set of ailerons that would do justice to a Spitfire or a rate of climb of 1,000ft/min have in store a pleasure—one that will warrant, we hope, the battle fought to achieve its resurrection from the inevitable and drawn-out death that one associates with the thought of aircraft storage in a Royal Air Force maintenance unit.

LONDON AIRPORT DISCUSSED

AN indication that the central terminal area of London Airport may well expand from an island into a peninsular was given during the brief discussion period following the lecture *London Airport* presented by SIR JOHN D'ALBIAC, K.B.E., C.B., D.S.O. (Airport Commandant) before the Royal Aeronautical Society in London on November 6. Sir John had given an illustrated review of the planning, construction, organization and operation of the airport, and of its development over the past ten years. The illustrations included colour photographs of the central-area facilities, and four diagrams (reproduced on this page) indicating the growth of airport activity. During his talk Sir John disclosed that he is to retire from the post of Airport Commandant at the beginning of next year.

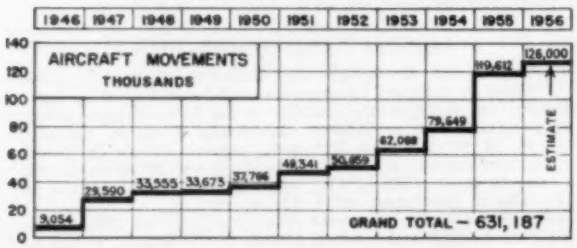
The discussion was opened by MR. B. S. SHENSTONE, M.A.SC., F.R.AE.S., chief engineer of British European Airways, who said that, while the runways and the new buildings at London Airport were most impressive, he was worried about the future of the central area. It would need to expand into a peninsular site to either east or west. Although an eastward link would be most convenient for occupants of the B.E.A. and B.O.A.C. engineering bases, he felt that expansion to the west might be more practicable. Runways 6 and 7, which in that event would need to be closed, were at present seldom used.

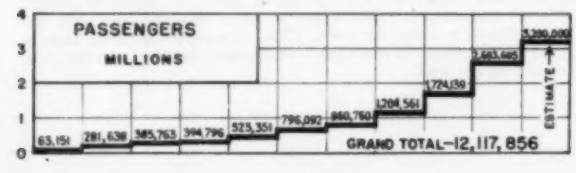
Whatever the direction of future expansion, Mr. Shenstone continued, plans should be made now. Already it was difficult for engineers to reach aircraft in the central area—the underground tunnel was expecially crowded at weekends—and a railway connection to the airport, if it came, would pour even more people into the area. A peninsular site would provide more scope for arranging aircraft (on systems such as the "finger" layout, for example), as well as giving the extra space needed so badly for aircraft, people and parked cars.

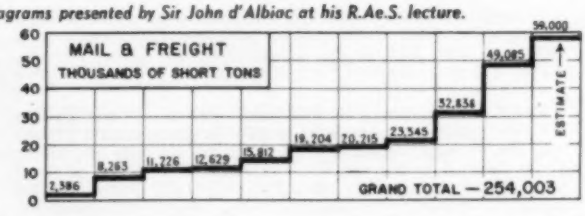
Replying, Sir John agreed with Mr. Shenstone that there were disadvantages to an island site, but "I don't like doing away with runways." No. 4 runway, he thought, was vulnerable in any case, and probably would have to be used for parking space. There were "five or six" schemes for the future planning of the airport under consideration now, and we must decide which was the best.

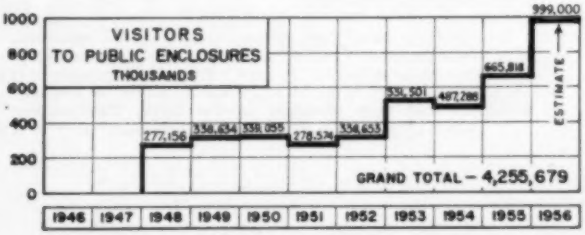
The next speaker was MR. PETER G. MASEFIELD, M.A. (ENG.), F.R.AE.S., managing director of Bristol Aircraft, Ltd., who began by complimenting the ground controllers at the airport for their

Ten years at London Airport, 1946-56: four informative diagrams presented by Sir John d'Albiac at his R.Ae.S. lecture.









LONDON AIRPORT DISCUSSED . . .

great courtesy at all times. It was a shame, he thought, that Fido was not installed there; he hoped that one day it would be.

In the speaker's opinion, several fundamental errors had been made in the planning of London Airport. Firstly, the use of a central island site precluded expansion outwards or upwards (and the nature of the ground ruled out expansion underground). An easterly peninsular site seemed to be advisable. Secondly, the central taxiway on the apron meant that passengers had to be "bussed" out to aircraft on the outer boundary of the apron—and Mr. Masefield did not like buses.

The third point was that there was not enough aircraft-parking space; a system incorporating gates and fingers should be adopted. Other criticisms were that the staff accommodation was crowded and had a "below decks" atmosphere; no aircraft fuel supplies had been piped to the central area; and a good approach to the airport was a vital need. Mr. Masefield hoped that the lessons learned here would be applied in the planning of Gatwick.

MR. A. C. CAMPBELL ORDE, C.B.E., A.F.C., F.R.Ae.S., operations development director of B.O.A.C., next spoke on behalf of his Corporation, agreeing basically with what Mr. Shenstone had said. More attention should be paid, he submitted, to the functional problems of aircraft systems and servicing for, with the use of large aircraft, current mobile equipment (such as large diesel-engine units) on the apron did not provide the answer. Sir John d'Albiac, in reply to one of Mr. Masefield's points, disclosed that a plan was in existence for piping petrol from the "petrol farm" to the central area. Finally, thanks to the lecturer were voiced by Mr. E. T. Jones, C.B., O.B.E., M.Eng., F.R.Ae.S., the R.Ae.S. president, who was chairman of the meeting.

Sir John d'Albiac surveys his command—the vast area of London Airport.

THE SHORT-HAUL AIRLINE

Mr. Anthony Milward, B.E.A. chief executive, whose lecture to the Aviation Forum is noted below.

THOUGH it bore the weighty title *The Problems of a Short-Haul Airline*, there was nothing weighty or dull about the Aviation Forum lecture in London on Wednesday of last week. It was given by Mr. Anthony Milward, O.B.E., B.A., whose reputation as a speaker seems to be fully in accord with the traditions of the office (chief executive of B.E.A.) to which he was appointed last May. He spoke for 90 minutes, without reference to notes, leavening his graphical slides with first-rate colour photographs of B.E.A. at work.

Starting with fundamentals, he likened his job to that of any manufacturer—the production of a commodity, in his case the airline seat. This was "the most perishable commodity in the world": it wouldn't wait, and if unsold it couldn't be kept on ice. The essence of B.E.A.'s problem was not only the inherent drawbacks of short-haul work—it was the "peak." It was apparent from his references to this dreaded word that B.E.A. regard the peak (and the peak-within-the-peak) as they do the weather, road congestion, or the economic squeeze—a challenge to their money-making abilities. Mr. Milward vividly illustrated this challenge by citing the London-Jersey route (which the bogy of the peak haunts most menacingly): "In a perfect world we would need 12½ aircraft, etc. on this route in August, and one in February." In practice, much was being achieved by encouraging mid-week travel by means of fare differentials.

Then, of course, there was the business of making money on international routes "in order to subsidize certain domestic routes" which the Ministry let it be understood B.E.A. should undertake. Here we mused upon a possible flaw in this Ministerial philosophy. Would it not be more businesslike to account (we use the word in its fiscal sense) for the two operations separately, with a subsidy from the Ministry for the "lifeblood" domestic services? Should part of our Silver Wing fare really go toward paying for a shepherd and his dog to fly by Heron to Barra?

It was satisfying to hear from Mr. Milward that B.E.A.'s drive for more freight was resulting in "rapidly increasing" revenue: from his mention of a projected automatic cargo-loading system for the Vanguard it was clear that B.E.A. are determined to strike out hard for big freight business in the years ahead. We were interested to hear him say, on the subject of staff efficiency, that *capacity* ton-miles produced per employee was a more significant index than revenue ton-miles. Although the latter is sensitive to uncontrollable outside factors such as credit squeezes, Britain's weather, London's traffic hold-ups and so forth, it could be argued that these things should be accepted as part and parcel of the tough and challenging commercial world in which B.E.A. lives.

We learned that the 2,500-hr utilizations being achieved by B.E.A.'s Viscounts possibly represented the attainable peak. Maximum utilization was of course most desirable, but the great art lay in scheduling to achieve a proper balance between the "right time to fill" and the "right fare." This point emphasized that there is no particular magic in impressive utilizations like 3,500 hr unless those hours are (a) convenient and/or (b) correctly priced. About the helicopter Mr. Milward said that "one of the most depressing pictures" in aviation today was the delayed promise of the truly commercial helicopter. In his opinion the Fairey Rotodyne was the one white hope.

Other points of special interest were (1) B.E.A.'s London maintenance base is to be doubled in size by 1960, with work due to start soon; (2) The Corporation has an option on ten Vanguards in addition to the firm order for 20; (3) Viscount 802s will be introduced in April (not by the end of the year, as previously forecast).

The discussion inevitably included questions about B.E.A.'s interest in jets: Mr. Milward felt that 1963 would be about the right timing, though no specification was mentioned. But he did say that no jet could ever come within 15 per cent of the Vanguard's economy, and that if B.E.A. ordered jets it would be because they had to rather than because they wanted to.

The discussion was a lively one—a good index of a lecture's interest.

J. M. R.

PICTORIAL PRESENTATION

"Photograms of the Year, 1957" (Annual Review of the World's Photographic Art). Published for "Amateur Photographer" by Iliffe and Sons, Ltd., Dorset House, Stamford Street, London, S.E.1. 136 pp., including 104 plates—eight in full colour. Price 18s 6d (postage 1s 4d).

HERE is the cream of another year's work by the world's best photographers, reproduced largely by photogravure process and also by single-colour and (in some exceptionally impressive cases) four-colour letterpress. The result is a volume of great and varied beauty, which can either be enjoyed visually by the layman or studied by photographers for example and inspiration to improve their own technique.

R. H. Mason, M.A., F.R.P.S., F.I.B.P., has written a plate-by-plate commentary, briefly appraising each picture's qualities; Stephen Bone, the painter and art critic, contributes some stimulating answers to the question "Is your colour really necessary?"; and A. L. M. Sowerby, B.A., M.Sc., F.R.P.S., editor of *Amateur Photographer* and now president of the Royal Photographic Society, has written an authoritative introductory article on the year's work, in which he describes the progress of photography in many different countries.

"FLIGHT" PHOTOGRAPHS

MANY of the photographs reproduced in *Flight*, i.e., those taken by our own photographic staff (as indicated on publication) are subsequently available in the form of high-quality prints. Prices are as follows (dimensions given in inches): 5½ × 3½, 1s 4d (glossy or semi-matt, unmounted), or 2s (toned sepia, unmounted); 6 × 4, 2s 6d or 4s; 8 × 6, 3s 6d or 5s 6d; 10 × 8, 5s or 7s 10d; 12 × 10, 6s or 9s 8d; 15 × 12, 9s 6d or 13s; 20 × 16 (semi-matt only), 13s or 18s.

Also available are a postcard series, totalling over 200, depicting both historic and modern aircraft of the R.F.C., R.N.A.S., R.A.F. and Fleet Air Arm. A list of this card series is obtainable on application. Prices are 8d each card, or 7½d each for quantities of a dozen or more. One view only—in most cases a good three-quarter front or side—is available for each aircraft type.

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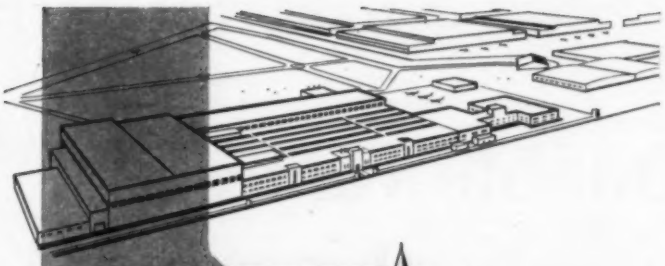
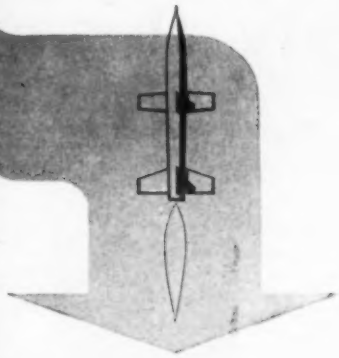
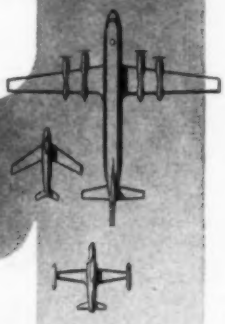
Canada has received world-wide credit for the part she has played in the development of a strong NATO. Aside from material contributions to other nations she has made an equally important contribution to world peace by being strong herself . . . by keeping abreast of civilian as well as military progress throughout the world. Canadair is proud to be a part of Canada's strength in three important fields.





CANADAIR and GUIDED MISSILES

Canadair has long had a prominent role in Canada's guided missiles program. The company's experience in advanced aircraft systems engineering is applied to the design and development of these new supersonic weapons for the Canadian government.

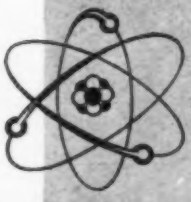


CANADAIR and AIRCRAFT PRODUCTION

F86 Sabre jet fighters: Canadair produces this famous fighter for the RCAF and other NATO air forces. The fastest flying, highest climbing fighter aircraft in European multi-squadron service, the Sabre jet has proved its superiority in actual combat.

T33 Silver Star trainers: This Canadair-produced jet aircraft has become the standard trainer for RCAF and NATO student pilots.

Canadair CL28: This is the largest aircraft ever to be built in Canada, and will be used for reconnaissance duties by the Maritime Air Command of the RCAF.



CANADAIR and NUCLEAR PRODUCTS

In this new field of activity, Canadair's facilities for design, engineering, development and research are directed toward the production of test reactors for the government authority, Atomic Energy of Canada Limited. Canadair contributes to Canada's continuing program for the development of non-military uses for nuclear products.

CANADAIR HAS PRODUCED MORE JET AIRCRAFT THAN ANY OTHER CANADIAN MANUFACTURER

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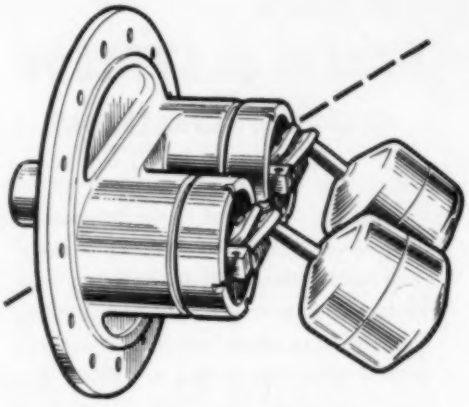
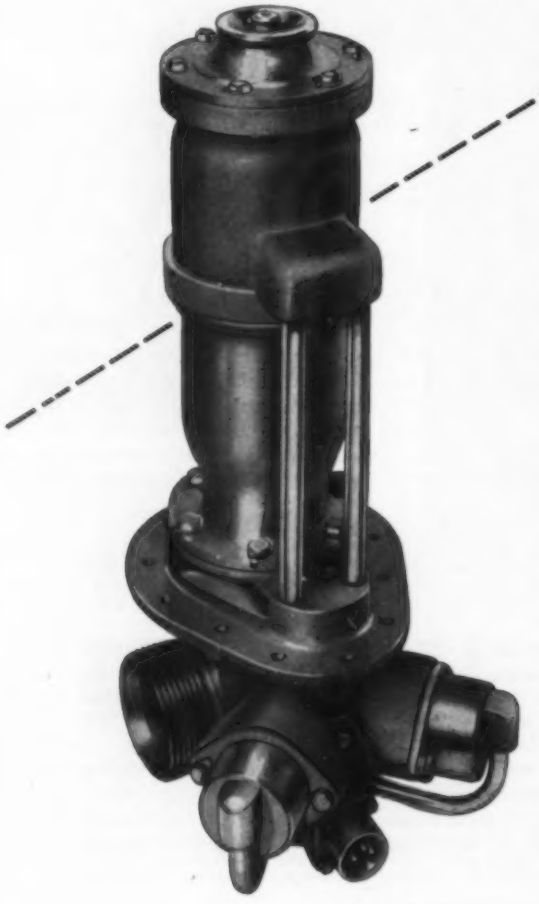
LIMITED, MONTREAL, CANADA

AIRCRAFT MANUFACTURERS

European Representative: J. H. Davis, Princes House, 190 Piccadilly, London W.1., England

Double valves supply the answer





Adequate venting for high rates of flow is always a problem. It may be desirable perhaps for structural reasons to achieve protection by double shut-off valves as opposed to adequate venting. In such cases the double shut-off feature of the F-R Mk. 32 Refuelling Valve provides a solution. This component comprises two valves operated independently by the two-level float switch illustrated. If either the primary valve or its associated float switch should become unserviceable the secondary valve and float switch will operate.

MK. 32 DOUBLE REFUELLING VALVE
(supplied for tank or line mounting)

Weight	4 *lb.*
Pressure loss at 60 g.p.m.	6.5 *p.s.i.*
Current consumption (continuous rating)	0.23-0.32 *amps.*
Type of connection	4-*pin Breeze plug.*
Float switch rating (inductive load)	7 *amps at 28 v. D.C.*
Weight of Switch Unit	1 *lb.* 12 *oz.*

FR PRESSURE REFUELLING COMPONENTS—ALL ALONG THE LINE!

FLIGHT REFUELLING LIMITED

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THE AERONAUTICAL BOOKSHELF

"Test Flight," by "Sandy" Powell (W/C. H. P. Powell, A.F.C., A.F.R.Ae.S.). Allan Wingate, Ltd., 12 Beauchamp Place, London, S.W.3. Illustrated. Price 15s.

DURING the war when Sandy Powell was at Boscombe Down he was flying a special Mosquito adapted to carry the Wallis dam-busting weapon. At the time (in his own words) he "was concentrating too much on the 'Black Horse' at Durnford and not enough on a stall turn; the Mosquito fell from the stall inverted and gathered speed in a dive. At the same time the ailerons heavied up so much that I could not roll out. After trying to recover by using a lot of rudder without success I thought it might pay to see if the aeroplane, having got itself into this involuntary predicament could get itself out and so I folded my arms. It at once performed some very strange tricks and then slowly rolled on to its side leaving me only to finish off the exercise."

It is fortunate that that Mosquito proved so sensible; otherwise, probably, we should not now have this book. W/C. Powell is well qualified to write about the work of test pilots, for he played a large part in establishing the Empire Test Pilots' School and was Assistant Commandant there. Among his ex-pupils are many famous names, among them Neville Duke, Peter Twiss, Dickie Martin and Ted Tennant. In *Test Flight* he has managed to combine the authority of an academic treatise with the understanding gained from practical experience; thus his book (despite its rather flashy dust-jacket) is a good antidote to the "glamourized" view of a test pilot's work.

He deals in considerable—but clear and readable—detail with every aspect of the art of test-flying. He cites some typical risks that test pilots face, and he illustrates their zeal for accuracy and their sense of humour. (Of the latter, there can be few better examples than Dickie Wheldon's recipe for a 12-turn spin at Farnborough: "Climb up to 6,000ft and start to spin over the aerodrome and look at Luton. When the town has gone round 12 times, come out.")

Sandy Powell pays no exaggerated tribute to test pilots when he says that without them "we should have no defence in the age of nuclear diplomacy and no airliners in an era of air transport. It is fortunate indeed for Great Britain—and the Commonwealth—that about a hundred of her citizens are happy to do this work for its own sake and because they think it is the finest job in the world."

There are errors in the book which will no doubt be corrected in any future edition. The Bristol 142 was sponsored by Lord Rothermere, not Lord Beaverbrook; Barnes "Wallace" on pp. 159 and 183 should of course be "Wallis"; and in a book of this nature the lack of an index is a serious omission.

"Best Flying Stories." Edited by John W. R. Taylor. Faber and Faber, 24 Russell Square, London, W.C.1. Price 15s.

FROM Homer to Hemingway, from Boccaccio to Max Beerbohm, there is nothing the world likes better than a good tale well told; and there is no finer source of good stories than the air, which has inspired a unique and exciting literature of fact and fiction.

In this new collection John Taylor has brought together some of the best examples of both kinds from the last half-century. Inevitably most of them draw their inspiration from the Second World War: here is Quentin Reynolds' breathtaking narrative of the Doolittle raid on Japan; H. E. Bates' poignant tale of an Australian bomber pilot, *The Young Man from Kalgoorlie;* and vivid Pierre Clostermann stories of a Messerschmitt 262 pilot and a Japanese suicide attack in a Baka.

But Richthofen, too, figures in the anthology, fighting his last fight; so does Bernt Balchen, conquering the South Pole; and, for the connoisseur, there is St.-Exupéry's matchless exposition of the aviator's craft.

"Into the Silk," by Ian Mackersey. Robert Hale, Ltd., 63 Old Brompton Road, London, S.W.7. Illustrated. Price 16s.

THE Caterpillar Club is certainly one of the most exclusive in the world. It has neither premises nor committee and its only emblem is the little ruby-eyed golden caterpillar given to each of its members. But the entry qualification is that a person should have saved his or her life in an emergency with a parachute of Irving design. Though the membership now totals some 40,000, none of these can willingly have completed the nerve-wracking initiation.

Mr. Mackersey has set out the history of the club since its formation in 1922 by Mr. Leslie Irvin, who developed the rip-cord parachute. He describes in some detail many of the more dramatic—even hair-raising—experiences suffered by those who escaped from stricken aircraft, adding for good measure the story of some who are not eligible for caterpillars because they survived without parachutes. The various types of escape are classified according to time and type of descent and told in a forceful, lucid style which, though it does not over-dramatize the story, leaves the reader in no doubt of the difficulties involved.

This is the sort of book that had to be written sometime, and one must be truly grateful to Mr. Mackersey for having done it so well. As one reads through *Into the Silk* one becomes increasingly horrified by the accounts it contains; but it is very difficult to put the book down before it is finished.

OTHER BOOKS RECEIVED

My Fifty Years in Flying, by Harry Harper. *Daily Mail* Publications Department, New Carmelite House, London, E.C.4. Price 12s 6d.

Vision, a Saga of the Sky, by Harold Mansfield. Duell, Sloan and Pearce, New York, U.S.A. Price $5.00.

Panic Takes Time, by T. W. Willans. Max Parrish and Co., Ltd., 55, Queen Anne Street, London, W.1. Price 15s.

Brassey's Annual, 1956. Edited by Rear-Admiral H. G. Thursfield. William Clowes and Sons, Ltd., Little New Street, London, E.C.4 Price £3 3s 0d.

The Haven-Finding Art, by Professor E. G. R. Taylor. Hollis and Carter, 25, Ashley Place, London, S.W.1. Price 30s.

Aeromodeller Annual, 1956-7, compiled by D. J. Laidlaw-Johnson and edited by C. S. Rushbrooke, F.S.M.A.E. Model Aeronautical Press, Ltd., 38, Clarendon Road, Watford, Herts. Price 10s.

Atomic Weapons and East-West Relations, by P. M. S. Blackett. Cambridge University Press, Bentley House, 200, Euston Road, London, N.W.1. Price 8s 6d.

They Shall Not Pass Unseen, by Ivan Southall. Angus and Robertson, 105, Great Russell Street, London, W.C.1 Price 16s.

Aircraft Annual, edited by John W. R. Taylor. Ian Allan, Ltd., Craven House, Hampton Court, Surrey. Price 10s 6d.

The One that Got Away, by Kendal Burt and James Leasor. Collins and Michael Joseph, 14 St. James's Place, London, S.W.1. Price 16s.

Satellite in Space, by Professor A. M. Low. Herbert Jenkins, Ltd., 3 Duke of York Street, St. James's, London, S.W.1. Price 10s 6d.

The World of Space, by Maurice F. Allward. Collins' Laurel and Gold series. 14 St. James's Place, London, S.W.1. Price 2s 9d.

Wing Theory, by A. Robinson and J. A. Laurmann. Cambridge University Press, Bentley House, 200 Euston Road, London. N.W.1. Price 75s.

Crash Pilot, by Dick Grace. Longmans, Green and Co., Ltd., 6 and 7 Clifford Street, London, W.1. Price 16s.

Radio Aids to Air Navigation, by J. H. H. Grover. George Newnes, Ltd., Tower House, Southampton Street, London, W.C.2. Price 21s.

Wings Over the Atlantic, by Robert J. Hoare. Phoenix House, Ltd., 38 William IV Street, London, W.C.2. Price 15s.

Fatigue of Metals and Structures, by H. J. Grover, S. A. Gordon, and L. R. Jackson. Thames and Hudson, Ltd., 30 Bloomsbury Street, London, W.C.1. Price 35s.

Vapour Trails, by Mike Lithgow. Allan Wingate (Publishers) Ltd., 12 Beauchamp Place, London, S.W.3. Price 13s 6d.

High Speed Aerodynamics and Jet Propulsion, Vol. 2, Combustion Processes, edited by B. Lewis, R. N. Pease and H. S. Taylor. Princeton University Press, Amen House, Warwick Square, London, E.C.4. Price 84s.

South to the Sun, by Betty Beaty. Mills and Boon, Ltd., 50 Grafton Way, London, W.1. Price 10s 6d.

Famous Air Routes of the World, by Harold Champion. Frederick Muller, Ltd., Ludgate House, 110 Fleet Street, London, E.C.4. Price 8s 6d.

Famous Airports of the World, by John Stroud. Frederick Muller, Ltd., Ludgate House, 110 Fleet Street, London, E.C.4. Price 8s 6d.

Technical Aspects of Air Transport Management, by R. Dixon Speas. McGraw-Hill Publishing Co., Ltd., McGraw-Hill House, 95 Farringdon Street, London, E.C.4. Price 64s.

Soviet Air Power, by Richard E. Stockwell. Pageant Press, Inc., 130 West 42nd Street, New York 36, U.S.A. Price $7.50.

CORRESPONDENCE

The Editor of "Flight" is not necessarily in agreement with the views expressed by correspondents in these columns; the names and addresses of the writers, not for publication in detail, must in all cases accompany letters.

Varsity Variant

HAVING read the article about the Royal Varsity in the October 19 issue of *Flight*, the idea struck me that the makers, Eagle Aircraft Services, Ltd., have built, with this aircraft, the first Vickers-Armstrongs V.C.3.

The V.C.3 was proposed around 1950 as a civil variant of the Varsity, to succeed the Viking on the production lines. The only mention I have ever found of this aircraft was in an American magazine, also around 1950. If my memory serves me well, the British Press never paid major attention to it [*Flight* published an artist's impression of this project, in the issue of June 22, 1950.—Ed.].

It would be interesting to know, taking in mind the fact that the Royal Varsity was modified to airliner standard, how this aircraft compares with the V.C.3 proposal.

Rhenen, Netherlands. CH. H. PARIS.

Terminology of Propulsion

ALTHOUGH I cannot claim expert knowledge of terminology, either aeronautical or otherwise, I feel urged to comment on the leading article in the October 26 issue on the relative merits of the terms "airscrew" and "propeller."

Surely, if a choice has to be made between the two, the more descriptive word "airscrew" is the better. This is exactly what it does, whether it is placed in front of or behind the aircraft.

Apart from this, as modern jet aircraft are undoubtedly propelled, should we not, to be completely logical, include the gas turbine engine under the generic term "propeller"?

Weymouth, Dorset. W. O. DOYLEND.

I WAS sorry to see, in a leading article on October 26, that you intend to use "propeller" in preference to "airscrew." I have never subscribed with much enthusiasm to the alleged need for drawing a fastidious distinction between propellers and airscrews, but I prefer the latter term. Nor am I alone in that, because most other nations do too—in France an airscrew is *une hélice*, in Germany *eine Luftschraube* (a most literal translation of "airscrew") and Italian, like French, favours its own version of *helixelica*. I think you'll also find that Dutch, Danish and Spanish all have words derived from screw or helix. I know that there are French and Spanish alternatives in *propulseur* and *propulsor* respectively, but they are rarely used.

Now, I suppose, somebody will tell me that no one could ever speak of such things as turbo-airscrew or airscrew-jet types, rather than turboprops or propjet! But I shall continue to prefer to speak of the airscrew shaft rather than the propeller shaft; the latter inevitably conjures up visions of engine-room telegraphs and other nautical appurtenances.

Manchester. HELIX.

The Sopwith 1½-Strutter

IN the history of the Sopwith 1½-Strutter [*Flight*, September 28 and October 5] I am afraid I unintentionally perpetuated some erroneous beliefs (which I had accepted as facts) relating to aircraft armament. That eminent authority, Mr. A. R. Weyl, A.F.R.Ae.S., A.F.I.A.S., F.B.I.S., has kindly—and necessarily—written to me about these matters, and I think it is essential that readers should have details of the corrections.

Mr. Weyl tells me that August Euler's patent (D.R.P. 248,601, dated July 23, 1910) was no more than a proposal to mount a fixed, forward-firing gun on an aeroplane, and that he envisaged installation *in a pusher aircraft*. This clearly means that Euler had no connection with synchronizing mechanisms. His idea was briefly exhibited at the 1912 DELA Show in Berlin but, at the request of the Germany military authorities, the gun was removed after only a few hours.

Fokker and Schneider did not at any time collaborate in the design of a machine-gun synchronizing device: the reverse was the case. Some time before the outbreak of war Schneider conceived the idea of firing a machine-gun through the hollow airscrew shaft (or propeller shaft, as *Flight* would now have us call it) of an aero-engine. This was an impossibility on contemporary rotary engines, so he approached Daimler with a proposal that an in-line engine should be inverted and an offset geared drive to the propeller fitted in order that the installation of the gun might be facilitated. The early inverted engine suffered from oiling-up of the plugs, and the idea was apparently abandoned after disagreement had arisen between Schneider and Daimler; no installation or firing tests were made.

In 1913 Schneider obtained patent D.R.P. 276,396 for a means of coupling the mechanism of a machine-gun to the propeller shaft. This was probably the earliest patent granted anywhere for a form of synchronizing mechanism, but unfortunately for Schneider it was taken out in the name of the firm employing him, the Luft-Verkehrs-Gesellschaft. Additional patents covered non-rigid installations of the gun. After Schneider found that Fokker had succeeded in making an interrupter gear, legal battle was joined; the L.V.G.—not Schneider—emerged victorious to the tune of 7,500,000 marks indemnification, paid to them by the German Government and Fokker for infringement of patent rights.

The Schneider story leads naturally to the truth about the primitive deflector-plate device used by Gilbert and Garros. Schneider's patent had been published in the pre-war aeronautical journals and no doubt came to the attention of L. Saulnier, designer of the Morane-Saulnier monoplanes. Mr. Weyl believes that Saulnier may have been the first to conduct actual firing trials with a gun-synchronizing gear: that was in June 1914. Just as early British experiments had proved unsuccessful because an unsuitable gun (the Lewis) was used, so did Saulnier fail to produce a workable synchronizing gear. This was because he used the Hotchkiss gun, from which synchronized fire would have been possible at only one given engine speed, owing to the system on which the gun functioned. Saulnier therefore abandoned his experiments and resorted to armouring the propeller blades—the idea which has always been wrongly attributed to Gilbert.

Mr. Weyl confirms a hazy memory that I had of reading somewhere a note of a Russian synchronizing gear. That gear existed early in 1915, before the Fokker device, and was a cam-operated mechanism applied to a Maxim gun. The installation was made in a Sikorski S.16, but was not developed.

Another correction of a different kind is called for on page 542 of *Flight* for September 28. There I referred to a Sopwith seaplane Type 806. That is wrong, for Sopwith Type 806 (i.e., Admiralty Type 806) was the Sunbeam-powered Gun Bus. Type 807 was the Monosoupape-powered seaplane with folding wings.

Birmingham, 32. J. M. BRUCE.

Hendon Memento

I SEND you herewith a special envelope prepared in Hendon to celebrate the recent 45th anniversary of the first United Kingdom airmail. This cover was designed by the writer and an artist colleague, and only one printing was made: 200 blue, 300 sepia, and 500 black. In the first edition there was an error in the spelling of the name of Twiss; this is being rectified soon by the issue of another small printing.

Originally designed with the *Flying at Hendon* exhibition [held at Church Farm House Museum, Hendon, and described in *Flight* of June 1st this year] in mind, the envelope became purely a private issue by two enthusiastic artists interested in the history of Hendon Aerodrome. Two envelopes are known to have been autographed by Claude Grahame-White, and another was autographed by several pioneers named on the cover who attended the opening of the Exhibition.

London, N.W.7. F. G. FOLEY.

The "Hendon" envelope referred to by Mr. Foley.

OVER £500 AND 400 MAN HOURS SAVED

Record of Goodyear-Equipped Dakmaster

Conversion of Transair's new Dakmasters to Goodyear wheel and brake equipment has proved a complete success.

Records of the first Dakmaster to be converted (in October, 1955) show that during the first nine months on Goodyear it flew 1500 hours and during this time:

* Saved £500 replacement costs and over 400 man hours compared with a similar flying period previously.
* Had hundred per cent. trouble-free operational record. No delays.
* Made over 750 landings without change of brake linings. In fact, the Goodyear linings were still good for a lot more wear.

With Transair, as with other national and international airlines, Goodyear equipment has proved more efficient and reliable.

INFORMATION

Full information about all Goodyear Aviation Products obtainable from Room 2194, S.E. Face Building, Central Area London Airport, Skyport 1133, or the Aviation Division, Wolverhampton.

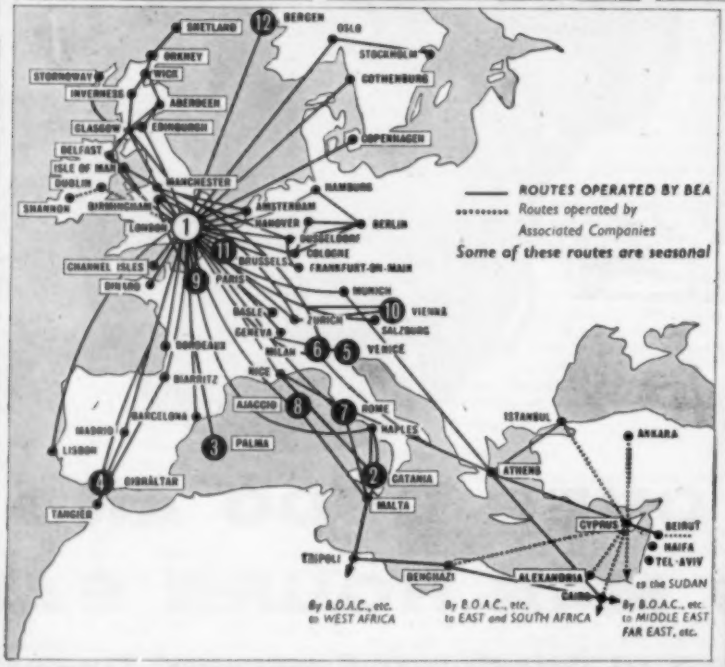
Illustration shows Transair wheel-well doors conversion TRA/M/91

GOODYEAR AVIATION PRODUCTS

Wheels · Brakes · Tyres

GOODYEAR TYRE & RUBBER CO. (G.B.) LTD · AVIATION DIVISION · WOLVERHAMPTON & WALLASEY

The BEA historical map of Europe



1. *Sir Walter Raleigh (1552-1618) pioneer of the English colonies.*
2. *Garibaldi leading his "Thousand" in Sicily, 1859.*
3. *Chopin and George Sand who went to Majorca in 1838.*
4. *The English fleet under Admiral Rooke capturing Gibraltar, 1704.*
5. *Marco Polo (1254-1324), Venetian explorer, on his way back from China.*
6. *Frederick Barbarossa, German Emperor, entering Milan, 1162.*
7. *The Roman Emperor Caligula (A.D. 37-41), who declared his horse Incitatus a priest and a consul.*
8. *Napoleon, born in Corsica in 1769, on board H.M.S. Bellerophon after his defeat at Waterloo.*
9. *The French Revolution, 1789. Storming of the Bastille.*
10. *Johann Strauss (1825-1899), Viennese composer of the "Blue Danube" and many other waltzes.*
11. *The Duke of Wellington at the Battle of Waterloo (1815).*
12. *Amundsen, Norwegian explorer, on his way to the South Pole (1911).*

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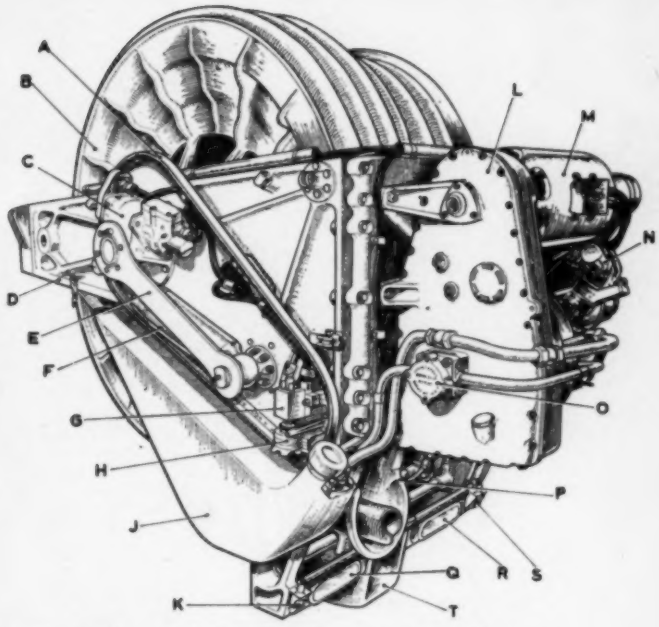
IN EUROPE'S FINEST AIR FLEET

BRITISH EUROPEAN AIRWAYS

Probe-and-drogue Practice

SUCCESSFUL development, by the parent company in England and by its namesake in America, have resulted in a large-scale trial of Flight Refuelling's probe-and-drogue equipment by the U.S.A.F. Tactical Air Command. The U.S. Navy and R.A.F. Bomber Command have also standardized it, though only the U.S. Navy has made regular and extensive use of it to date.

Tactical Air Command formations recently made an important mass movement of fighter bombers from America to Europe, using probe-and-drogue refuelling at points—unspecified—*en route*. A squadron of F-100Cs flew non-stop from Harmon Air Base, Newfoundland, to Sidi Slimane, Morocco, a distance of 2,891 miles, in 5 hr 11 min, at an average speed of 565 m.p.h. From Morocco they continued to Landstuhl, Germany. A squadron of F-84Fs flew 3,787 miles non-stop from England A.F.B., Louisiana, to Morocco in 7 hr 39 min at an average speed of 510 m.p.h. A flight of RF-84Fs flew 4,307 miles from Shaw A.F.B., South Carolina, to Morocco in 9 hr 9 min at a speed of 473 m.p.h. The two last-named units then flew on to Aviano, Italy. The whole force is defined as a self-sustaining unit and is the first of its kind from T.A.C. to leave America in one operation.



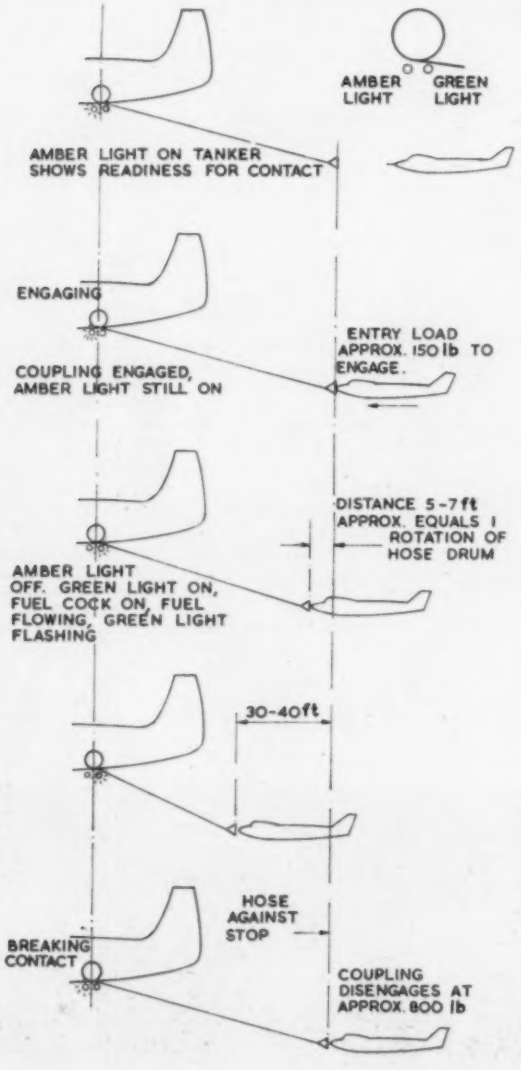
Port-side view of one of the latest hose-drum units. A, securing tray; B, hose drum; C, arrester mechanism; D, side-plate; E, tie bar; F, Liquid Spring; G, footage indicator transmitter; H, rotary switch assembly; J, fluid-drive oil reservoir; K, red signal light; L, primary-drive assembly; M, driving motor; N, scoop actuator; O, fluid-drive oil pump; Q, R, S, respectively amber, green and red signal lights; T, oil cooler.

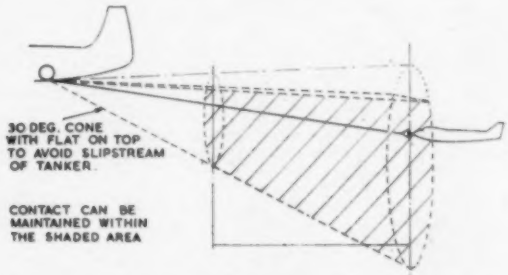
Though T.A.C. tankers use hose units semi-permanently attached under the wings and tail of their KB-50 tankers, the R.A.F. is standardizing a hose-reel unit which can be rapidly installed in the bomb-bay of a standard bomber, in many cases together with its transferable fuel tanks. Such a reel unit, having main components cast in magnesium, is shown above.

The refuelling operation is flexible and simple. The hose trailed behind the tanker is usually between 75ft and 100ft long, and the space-cone within which the receiver may move while in effective contact is very wide. Any pilot capable of formating on another aircraft can successfully use the probe-and-drogue method. There is no need for voice contact between tanker and receiver, nor for a skilled tanker operator. The throwing of a switch and the turning on of main transfer cocks controls the paying out of the hose and opening of fuel transfer circuits. When the tanker is ready for contact, an amber signal light on the reel unit automatically lights up for the receiver to see. The probe, which may be mounted somewhere on the aircraft or on an external fuel tank, is flown into the drogue to make automatic contact. A green light on the reel unit shines steadily when contact is made, and flashes while fuel is actually flowing.

When the receiver's tanks are full, valves automatically close, the green light shines steadily again, and the receiver can disengage by throttling back momentarily. In case of emergency, two red lights will indicate that contact must be immediately broken. The trailing hose is kept at constant tension by a variable torque unit in the hose reel pack.

The system is ideally suited for fighter operations, as the whole refuelling operation is under the direct control of the receiver pilot and the probe equipment is light and simple to install in a fighter which already uses pressure refuelling equipment on the ground. The probe can be made retractable.


AMBER LIGHT
GREEN LIGHT
AMBER LIGHT ON TANKER SHOWS READINESS FOR CONTACT
ENGAGING
ENTRY LOAD APPROX. 150 lb TO ENGAGE.
COUPLING ENGAGED, AMBER LIGHT STILL ON
DISTANCE 5-7 ft APPROX. EQUALS 1 ROTATION OF HOSE DRUM
AMBER LIGHT OFF. GREEN LIGHT ON, FUEL COCK ON, FUEL FLOWING, GREEN LIGHT FLASHING
30-40 ft
HOSE AGAINST STOP
BREAKING CONTACT
COUPLING DISENGAGES AT APPROX. 800 lb



(Left) Sequence of the refuelling operation shown diagrammatically. (Above) The contact area can be represented as a truncated cone.

The Petbow GSU 126 Mk II "Power Puller" ground starter and tractor in attendance on the Rolls-Royce Tyne-Lincoln.

THE INDUSTRY

Honeycomb Applications

NEW information sheets are available on the honeycomb cores produced by Aero Research, Ltd., Duxford, Cambs, supplementing data already published.

Metal honeycomb, usually made from aluminium foil, is claimed to have advantages over other sandwich materials for aircraft structural applications by reason of its very consistent physical properties and its climate-proof attributes. It is fireproof, non-absorbent and proof against insects, moulds and vermin. It is easy to fabricate in panels of the desired dimensions, and for varying requirements it can be made in different strengths and densities. When bonded to the facing sheets by the Redux process, state Aero Research, the material can give a sandwich capable of operating at skin stresses of 50,000 lb sq/in, thus making possible a very low structural weight.

Aluminium honeycomb is made by the company in three cell sizes—$\frac{1}{8}$in, $\frac{1}{4}$in and $\frac{1}{2}$in. These dimensions refer to the diameter of a circle inscribed in the cell.

Power and Pull

THE GSU 126 Mark II is the latest in a long line of ground power units made by Petbow, Ltd., Sandwich, Kent. Like most of the company's recent g.p.u. equipment it is capable of starting the largest aircraft gas turbines. This involves bringing the rotor from rest up to several thousand r.p.m. before the fuel is ignited, which demands a heavy and sustained supply of electrical power beyond the capacity of any normal battery.

At the same time, the GSU 126 can also be used as an aircraft tractor, with a maximum draw-bar pull of 15,000 lb. It is powered by a four-cylinder Rolls-Royce oil engine and can generate up to 2,000 amp at 28 V d.c., 1,000 amp at 112 V or 120 kVA of 208-V 400-c.p.s. current.

This year, incidentally, Petbow, Ltd., celebrate their silver jubilee. The firm was founded at Willesden in 1931 by Mr. J. A. Peters, who as a young man had been a pioneer aircraft designer. In 1919 he flew from London to Madrid in $7\frac{1}{2}$ hours with Lt. W. R. Curtis, R.A.F., in an aircraft designed by himself. This was the Seabird, built by the Alliance Aeroplane Co., and powered by a 450 h.p. Napier Lion engine.

New Air Drying Equipment

THE dryer division of Birlec, Ltd., Tyburn Road, Erdington, Birmingham, 24, has supplied for de Havilland Propellers, Ltd., a Lectrodryer which is described as able to dry 360 cu ft/min of saturated condensate free air at 70 deg F, flowing at 1,000 lb sq/in to an outlet dew point of −55 deg C at atmospheric pressure.

This equipment, arranged for electric re-activation heating and water cooling, has a motor-driven re-activation blower; and to absorb oil carry-over, the equipment is provided with a dual pre-filter consisting basically of a pressure vessel containing activated alumina. Dry air from the outlet goes through a ceramic-type dust filter capable of stopping particles larger than five-micron size.

Birlec, Ltd., who are well known as manufacturers of industrial furnaces as well as dehumidification equipment, have announced a ten-year development plan for a new factory on a 34-acre site at Aldridge, near Birmingham.

Advice on Flexible Tubing

IN 1952 the Compoflex Co., Ltd., opened a "Flexibles Centre" at Grosvenor Gardens, London, where information and advice was available concerning the uses of flexible tubing and hose of the many different kinds manufactured by the company. So successful was the venture that in due course a similar centre was opened at Oldham, Lancs; and now a new and enlarged London establishment has been inaugurated, at Northumberland Avenue, W.C.2.

The new premises, which are on three floors, each of some 3,000 sq ft, were opened on October 25 by Sir Norman Kipping, director-general of the Federation of British Industries. The first floor and basement accommodate the administrative staff, and on the ground floor is a comprehensive exhibition divided into sections dealing with liquids-handling; the handling of non-liquids; and metallics, plastics and rubber.

The Compoflex Co., Ltd., claim that they are the only manufacturers in this country making metallic, rubber, plastic and composite hoses. Simultaneously with the opening of the new centre the first publication of a quarterly journal was announced; entitled *Arteries of Industry*, it will contain technical and other articles on all aspects of flexible-tubing application.

IN BRIEF

After 34 years at Dale End, Birmingham, the Midland headquarters of Chloride Batteries, Ltd., are now at a new supply depot at Colliery Road, West Bromwich, Staffs.

* * *

Mr. W. A. Hartop, works director of George Kent, Ltd., is now in Canada and is spending some time in Toronto to review progress at the Kent manufacturing subsidiary there, Kent-Norlantic, Ltd.

* * *

New plant for the oil seal division of George Angus and Co., Ltd., manufacturers of the "Gaco" series of seals and hydraulic packings, was recently opened by Maj. Gwilym Lloyd George, the Home Secretary. The plant occupies a 19-acre site in Coast Road, Wallsend-on-Tyne.

* * *

The Hymatic Engineering Co., Ltd., Glover Street, Redditch, Worcs., have produced a most attractive book called "Air is in the Air," describing and illustrating not only their design and production of compressed air equipment for aircraft but also their resources, organization and outlook.

* * *

Rotax, Ltd., announce that Mr. V. J. H. Meyer, at present sales manager, has been appointed service executive, with responsibility for "co-ordinating all aspects of service on a world-wide as well as a domestic basis," and will be assisted by Mr. E. W. Barrington as service manager. As a result of these appointments, Mr. P. Griffiths becomes commercial manager, assisted by Mr. E. G. Thomas as sales and export manager and Mr. W. J. Philpin as technical sales manager.

A revised catalogue containing comprehensive data on the complete range of Standard plugs and sockets manufactured by the Plessey Co., Ltd., Ilford, Essex, is now available. It shows not only the connectors and accessories in current use but indicates replacement types for discontinued and obsolescent components. Comparative tables of Plessey part numbers and Air Ministry numbers, arranged for easy reference, are also included.

Three new test pilots have joined the staff of A. V. Roe and Co., Ltd. They are (left to right) A. L. Blackman, M.A., D. W. Haskett and Anthony Jones. The first-named has been a Boscombe Down pilot; the others have been flying in Canberra squadrons.

BRITISH MESSER

SOLDERLESS TERMINALS & CONNECTORS

PRECISION CRIMPING GIVES

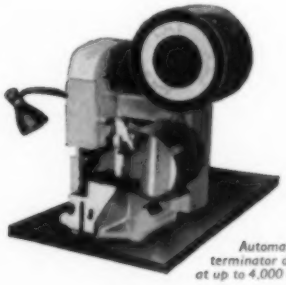
▶ *Faster working* ▶ *Greater economy* ▶ *Freedom from human error*

The AMP method of wire connection achieves a standard of electrical performance, mechanical efficiency and speed of output unobtainable by other methods. AMP terminations or connections are made to a uniform standard of excellence. They will not fail under vibration, strain or corrosive conditions; they give good performance at high altitudes and are particularly suited to electronics and general aircraft wiring.

AMP terminals are made for every type and size of wire

Brochure "F" sent or demonstration at your own works on request

Pneumatic hand tool eliminates operator fatigue



Automatic wire terminator operates at up to 4,000 an hour

AIRCRAFT-MARINE PRODUCTS (GT. BRITAIN) LTD.

London Sales Office: 60 KINGLY ST. W.1. Tel: REG 2517/8. Works: SCOTTISH INDUSTRIAL ESTATES, PORT GLASGOW, SCOTLAND

Ahead of the present — — abreast of the future

AP323-14

Napier's determined bid to procure big turboprop-conversion business is exemplified by this picture of the company's Eland-powered development fleet. The three aircraft—a Convair 340, an Ambassador and a Varsity—have now amassed 1,670 engine-hours.

CIVIL AVIATION

BERMUDA REVISION

IT has been decided to revise the terms of the Anglo-American Air Agreement signed at Bermuda in 1946. For ten years this agreement has successfully ensured that, in the operations of B.O.A.C. and U.S. carriers, a fair balance between competition and the protection of national interests is achieved. It was, in fact, an agreement which set the pattern for the countless "bilaterals" negotiated since.

The decision to revise was taken at the end of the Anglo-American talks last week (*Flight*, November 2); negotiations on the revision will start early next year.

This is an important move, and it would appear that something more than the traffic-rights machinery is breaking down. The governments concerned have issued only guarded statements about the talks, but possibly the Bermuda clause giving trouble is that providing for the regulation of capacity: its terms are vague, allowing review of the situation if one party feels its interests being "unduly" affected by the other. A further capacity clause states that, where fifth-freedom rights are involved, capacity on *through* services should bear "reasonable" relationship to end-to-end traffic. This latter is decidedly vague, and the governments concerned have probably decided that the time has come when they must determine just how reasonable is "reasonable."

MORE POINTS FROM WESTMINSTER

IN last week's issue we summarized the main points raised in the civil aviation debate in the Commons on November 2. A number of other significant items are here recorded.

Discussing the Corporations, MR. FRANK BESWICK (Lab., Uxbridge) paid tribute to their achievements during the year, but put two questions of financial detail to the Minister. The first related to the sum of £354,000 "set to the credit of [B.O.A.C.] . . . and held against 'unused flight coupons.'" Mr. Beswick felt that this was "a nice little sum to pull down one's sleeve," and felt that it had significance in relation to the £117,000 margin of profit. His second question concerned B.W.I.A.'s loss of £360,000, about which he thought more information should be given.

Later in the debate, MR. ARTHUR PEARSON (Lab., Pontypridd) said that it seemed to him to be "farcical" that the two Corporations do not jointly send their engine repair work to the successful B.O.A.C. establishment at Treforest. Was it not wasteful for British European Airways to build up its own separate base at London Airport, as it had declared its intention to do?

On the question of crew fatigue (a matter to which we drew attention in a leading article on April 27), MR. WATKINSON, Minister of Transport and Civil Aviation, said that he had had considerable discussions with B.A.L.P.A. and other organizations to try to get the regulations for flight-time limitations right. "It has not proved possible to reach agreement with all the interested parties on all possible detail, and I do not think I ever shall." However, he hoped soon to lay revised regulations before the House, and he was prepared to examine them again if need be.

A point about M.o.S. contracts was raised by MR. BESWICK. Referring to Vickers-Armstrongs Aircraft, Ltd., he said that he could only think that the M.o.S. said about this firm: "It is doing very well on its own; it is selling its machines. It does not need assistance. We must try to find assistance for the less successful ones." He suggested that this was not planning—it was "merely propping up." On the same M.o.S. topic MR. IAN MIKARDO (Lab., Reading) said it was easy enough to build up a big export trade in an industry in which the Government "took all the risks, paid for almost all the research, put *carte blanche* on development costs, and got the Corporations to get all the snags out of the aircraft after they had been delivered not merely late but also defective." We were, he said, "shielding and cushioning the most inefficient industry in the country . . . which, with the connivance of the Government, refuses every request that somebody should have a close look at it."

DR. REGINALD BENNETT (Con., Gosport and Fareham) suggested that the business of exporting airliners was not being made easier by financial problems. He understood that the risk on the money raised from the Air Finance Corporation was taken up as to 15 per cent by the manufacturers and as to 85 per cent by the Export Credit Guarantees Department. "I fail to see why there should be such a very high rate of interest. I ask my Right Hon. Friend to look into the matter and to try to devise a better way of helping not only British airlines but foreign airlines. Capital Airlines of America, buying our Viscounts, had to take its money from this very expensive source."

Until last week no official information about China's civil aviation was forthcoming. We hope to say more in an early issue of the illuminating timetable just released by the Chinese Civil Aviation Administration; in the meantime we reproduce the airline's baggage label.

SWISSAIR AND THE ELECTRA

A STRONG team of nine Swissair executives, led by the chairman, Dr. Rudolf V. Heberlein, and the president and managing director, Dr. Walter Berchtold, recently visited the Lockheed Aircraft Corporation at Burbank. The object of their visit was to discuss technical aspects of the Electra; they examined the full-sized interior and functional mock-ups and conferred with the chairman of the Lockheed board, Robert E. Gross, and the president, Courtland Gross, as well as senior engineering personnel.

It is unusual for most of the senior executives of an airline to visit a manufacturer unless the smoke is very near to flame; if Swissair do place an order they will be following the precedent of six other airlines which have now ordered 128 Electras.

American manufacturers spare no effort to ensure that their photographs illustrate the product to its best advantage. Here, at a glance, is the difference between the new 1649A Super Star Constellation and its 1049H Super Constellation predecessor.

CIVIL AVIATION . . .

COCKPIT VIEW

GOOD sense—pungent good sense—is the contribution that airline pilots can bring to air safety. Their qualifications are professional experience and personal responsibility; if they are sometimes outspoken, they are nevertheless sincere and frequently discerning.

The Transport Airplane from the Pilot's Viewpoint was the title of a paper recently read to the U.S. Society of Automotive Engineers by Captain R. F. Adickes of the American Air Line Pilots' Association. In his remarks he commented upon many current practices to which he was opposed and presented much constructive criticism that is worthy of quotation.

Dealing first with cockpits and controls, he made the point that "the transition between aircraft types by individual pilots requires a basic similarity of controls . . . the myth of less complex operation [with jet transports] has been exploded. Airline pilots are entering a new era with the most demanding and unforgiving aircraft we have yet known. The split-second timing requires careful placement of every switch and lever." The placement, Capt. Adickes constantly re-emphasized, "should be decided by the users."

"Pilot error" is now generally becoming recognized as the effect of some external cause—pilot fatigue, inadequate training or faulty design—"cockpit booby-traps" was the lecturer's term. Action to correct obvious faults was not being made sufficiently quickly, he complained: "Have the designers of our accident-prone aircraft disavowed their product? Why do obvious design errors continue to fly?"

Capt. Adickes was in favour of the N.A.C.A. after-impact "water inerting" device, which floods hot areas of the engine with sufficient water to cool them below the ignition point of the fuel. A.L.P.A. has now made a thorough study of this principle and endorses it without qualification. "We believe," said Capt. Adickes, that "water-inerting should receive priority consideration over noise suppression."

Back to the attack came the lecturer with his assessment of the interpretation of performance requirements by designers and flight-test engineers. "The last drop of blood has been squeezed out of the C.A.R. requirements," he said. "Flight-test data for compliance with C.A.R. is obtained under ideal conditions which are the exception rather than the rule in airline flying. Our take-off record has only been good because of engine reliability rather than adequate safety margins . . . ten per cent more runway length would contribute greatly towards increasing the safety and efficiency of operations."

Flight evaluation programmes with manufacturers were "appreciated so much" by A.L.P.A. pilots that they had suggested that airline pilots would benefit from conferences with the manufacturer's test pilots and demonstrations of unusual flight conditions. The probability and consequences of misuse of controls such as those operating the cowl flaps [the author was citing the case of a recent ditching] should be investigated by the designers and flight test crews, Capt. Adickes suggested.

To conclude his lecture, the author pleaded for co-operation between engineers and scientists and the pilots of scheduled airlines. "We are pleased to say that this is a growing trend in industry. We welcome all opportunities to offer our contributions."

NEW AIRPORT FOR FIJI

A FINAL decision on the development of an airport in Fiji adequate for future jet air transport across the Pacific was sought by the representatives of six British Commonwealth administrations who recently met in Melbourne. The provision of a suitable airport in Fiji was the most important issue. At its last meeting the South Pacific Air Transport Council had set up a working group to examine the question, and this recent meeting considered this group's report. The outcome was a proposal to rebuild the international airport of Nandi, Fiji, which is administered by New Zealand. Possible cost could be in the region of £2.5m.

The work expected to be undertaken for the development of Nandi Airport includes the strengthening of existing runways and taxiways, the strengthening and extension of the aprons, construction of a new terminal building and a new control tower and the acquisition of land to permit the extension of the runways. Improvement of the air navigation and communications facilities, which will incorporate new transmitting and receiving stations, I.L.S. and V.O.R. are also planned.

Delegations attending were: Australia (the host nation), led by Mr. Athol Townley, Minister of Civil Aviation; the United Kingdom, led by Mr. E. A. Armstrong, Under-Secretary (Safety and General), Ministry of Transport and Civil Aviation; New

It is pleasing to hear that this Canadian-Vickers-built Supermarine Stranraer is still at work in the Vancouver area.

(Right) Prototype cardboard DC-7C now in production in kit form. An Englishman, Mr. Wallis Rigby, has long specialized in ingenious "cut and fold" products of this kind for supply to airlines.

Shade of the outback: A T.A.A.-owned and serviced D.H. Drover of the Royal Flying Doctor service lands at a remote Australian farm.

Zealand, led by Mr. T. P. Shand, Minister of Civil Aviation; Canada, led by Brigadier C. S. Booth, Assistant Deputy Minister of Transport; and Fiji, led by Mr. H. W. Davidson, Financial Secretary, Fijian Administration.

BRIGHTER TIMETABLES

"TODAY, the timetable plays an important rôle in modern society. Tycoons are confused without one, film crooks never plan their getaway without consulting one, and in the spring, when holidays are in the air, the timetable appears to replace the ubiquitous library book under the arms of every City worker on the 8.15 to town."

These words accompany the issue of K.L.M.'s latest timetable. With it the Dutch airline introduces a new style of guide to its world services. All tables are fully indexed, maps of services extend to four pages, and a distinction has been made between first-class and tourist fares by printing them in different type.

A triviality, perhaps, among air transport's more weighty affairs—but indicative of K.L.M.'s alert approach to the selling of seats. The compilation of a timetable is an immense task; but there seems to be nothing to lose in presenting it more attractively.

HERMES ACCIDENT

IT has been decided to hold a public inquiry into the accident to the Britavia Hermes G-ALDJ during final approach to Blackbushe on November 5. This was announced by Mr. Nigel Birch, Secretary of State for Air, in the Commons last week. The aircraft was evacuating Service families from Libya; of the 80 passengers and crew on board, four children and three of the crew (including both pilots) were killed.

BOEING MARKET

VERY rarely does a manufacturer proclaim the results of his market research. Thus when Boeing say that they have reckoned on a world market for 1,500 medium jets in the 1960s, other firms are certain to sit up and take note. Mr. Paul Ford, the company's director of finance, speaking at San Francisco on October 25, estimated that traffic growth will continue through the sixties at the 1950-55 average of 15 per cent, and that major airlines during the sixties will replace *all* their medium range piston aircraft, and smaller airlines one half. "Over and above the 400-plus Viscounts, Comets, Vanguards, Caravelles, Electras, and Convair 880s currently on order, we would estimate a medium and short-range jet transport market of up to 1,500 airplanes through the 1960s."

This is big business for three or even four manufacturers, and we can assume that the Boeing regard their 727 medium jet project as a serious contender. We would have liked to know Mr. Ford's assumptions and conclusions in greater detail. It is tantalizing to hear him skate over them briefly—thus: "We have made studies of passenger growth and schedule requirements in relation to the size and speed of jet airplanes. We have given careful consideration to operating cost requirements of our potential customers. The 'new tool' philosophy expressed by Mr. C. R. Smith, wherein the jet airplane becomes an economic must, has been evaluated. In addition, competitive situations between airlines, financial capabilities of possible customers, must be weighed properly to evaluate the potential market for commercial jet transports."

On the subject of the *big* jets, Mr. Ford says: "To date, we at Boeing have announced contracts or letter commitments for 136 of such airplanes. The Douglas company has announced sales in the neighbourhood of 115 to 120, I believe. This represents over 250 large jet airplanes on order for deliveries starting in late 1958. Currently, discussions are being held with a number of additional potential customers for both of these airplanes. At this time, we would estimate that another 100 to 150 of these airplanes will be sold for delivery within the next five or six years. For the next five years beyond that, another 100 to 150 airplanes could be sold. This latter figure is based on our estimates of big 'jet type' passenger seat miles to be flown, converted into jet aircraft required to do the job."

CESSNA 620

DOUBTS that have existed about Cessna's intention to go ahead with their four-engined executive transport (a stiff competitor of the Heron) have been dispelled by the firm's announcement that options for purchase—although not as yet firm orders—can now be accepted. The conditions of this arrangement call for a $10,000 deposit, returnable next March if the price (tentatively fixed at a maximum of $375,000) is exceeded or if the production schedule is unsatisfactory.

Along with the declaration that this sophisticated business transport—the 620 is pressurized, air-conditioned and very fully equipped with navigation aids—is to be quantity-produced, came much fuller dimensional data than have previously been published. After 25 hours of flight-testing Cessna announced that, using up-rated versions of the supercharged Continental GSO-526A horizontally opposed six-cylinder engine, the 620 would have a better performance and a higher maximum weight than had previously been stated.

With 350 h.p. at 3,200 r.p.m. now available from each engine for take-off, and 310 b.h.p. at 3,000 r.p.m. maximum continuous, the top speed has increased from 269 m.p.h. to 282 m.p.h., and a really useful cruising speed of 260 m.p.h. is available to carry 9-11 people in pressurized comfort at 12,500ft. With a full load of fuel and oil (535 U.S. gal and 20 U.S. gal respectively), a crew of two and 270 lb of baggage, the gross weight limitation of 15,000 lb reduces the number of passengers to six. With Hartzell 93in diameter constant-speed, fully-feathering propellers (with optional reverse pitch) to make best use of the increased power, the take-off distance over a 50ft obstacle with an engine failure at critical speed is 3,750ft, the normal rate of climb is 1,150 ft/min, and the three-engined service ceiling is 20,000ft.

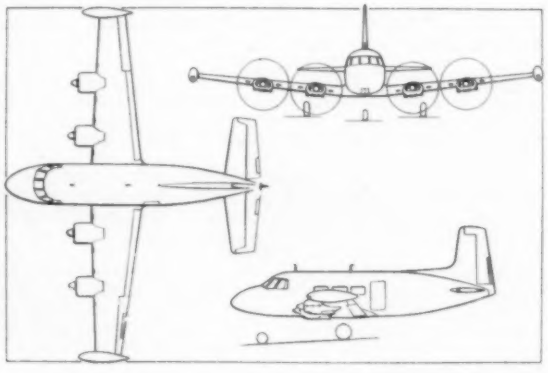
The tentative empty weight of 10,000 lb (Cessna have not yet finalized this figure) includes a 275 lb allowance for radio and electronics; provision has been made in the design for the installation of I.L.S., V.O.R., A.D.F., D.M.E. and training aids. A considerable amount of equipment can be installed on the optional-extra basis. The elevator, aileron and rudder primary controls and tabs, for example, are all designed to accommodate Collins autopilot and trim-servo installations; the Collins integrated flight system, non-skid brakes, pedal-operated hydraulic nose-wheel steering and passenger oxygen are other equipment items that can be supplied upon request.

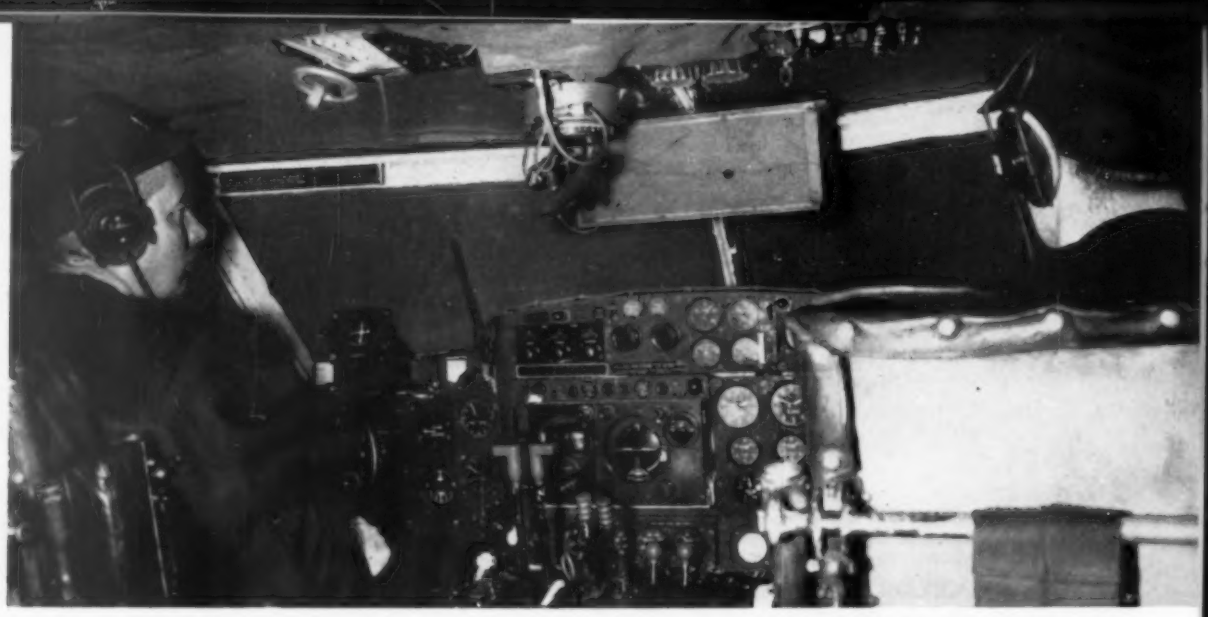
Creature-comfort for the far-travelling executive (maximum still-air range is 1,700 miles) should be of a very high standard. The cabin is parallel-sided and rectangular in plan. Tracks which run throughout the length of the floor can be used for positioning the seats or tie-down rings at spacing increments of one inch. The standard layout consists of five reclining seats and one folding table, with a baggage compartment, coat rack and lavatory aft of the cabin.

Pressurization, heating and air-conditioning are all supplied by the AiResearch gas turbine which also drives a 50-amp generator. Starting is independent of ground power supply; the normal procedure is to start the turbine on the nickel-cadmium battery and then use the electrical output to start the engines while the turbine air-conditions the cabin.

According to our American near-namesake *Flight Magazine*, Cessna have recently committed themselves to a $10m expansion programme with this and other projects in view. Deliveries of the 620 could probably begin late in 1958; some estimates of the market possibilities might justify a production rate of 100 a year.

General arrangement of the Cessna 620.





For a year now Silver City's Bristol Freighters have been using the Decca Navigator. In this unusually good cockpit picture—taken recently over the English Channel—can be seen the Flight Log display, used in conjunction with the Mk 9 receiver.

CIVIL AVIATION . . .

AER LINGUS HALF-YEAR

A SURPLUS of £344,000 was achieved by Eire's airline in the first half of 1956—an increase of £31,000 over the same period last year. Passenger traffic increased by 18 per cent and eight per cent more revenue hours (17,370) were flown. The introduction in March of import-restricting levies—Mr. J. F. Dempsey, the Aer Lingus general manager, told his staff in Dublin on November 8—was responsible for a 159-ton reduction in the cargo carried. Mail was also down by 42 tons. The levies tended, he said, to reduce the volume of the type of goods handled by the airline.

The increase in revenue hours and improved scheduling were claimed by Mr. Dempsey to have contributed to the passenger load-factor of 76 per cent, the highest for many years; but increased expenses—noticeably for maintenance, landing and handling fees, agents' commissions and advertising—had increased the cost per ton-mile by twopence, to three shillings. An increase in excursion fares of between two and three per cent and in ordinary fares of between three and four per cent has been made.

Preparations are well advanced for the opening of new routes to Brussels, Frankfurt, Zurich and Rome as well as an extension from Manchester to Dusseldorf. Most of these routes should be established next year.

CAMBRIAN SAMARITAN

SYMPATHY for the plight of Hungary evoked last week a most generous gesture from the independent operator Cambrian Airways. The company's shareholders voted that one of the two Dakotas of the 14-aircraft fleet should be placed at the disposal of the British Red Cross Society to carry urgent medical supplies from Cardiff to Hungary and to fly Hungarian refugees back to England. The cost of these operations would be borne by Cambrian.

At the time of this offer the aircraft was undergoing a routine engine change, but the maintenance engineers at Rhoose worked throughout the night—and volunteered to forgo their pay—in order to have the Dakota ready for take-off by 9 a.m. the following day. In this they succeeded, but Red Cross difficulties in Vienna prevented the aircraft leaving on November 9 as intended; Cambrian say that their offer remains open and that the Dakota will be available if required.

BREVITIES

IT is reported in the Italian journal *Settimana Alata* that Hindustan Aircraft, Ltd., is considering an agreement for the production of the Fokker Friendship in India.

* * *

East African Airways, an associate of B.O.A.C., has announced a new service between East and Central African territories to be known as the "Federaliner."

* * *

Mr. A. E. Raymond, vice-president (engineering) of the Douglas Aircraft Company, has forecast that the jet airliners now in production will lift civil aviation on to a 600 m.p.h. "speed plateau" which should remain constant for at least ten years.

* * *

B.O.A.C.'s contract for the purchase of 15 Boeing 707s was formally signed in London on November 8 by Mr. Basil Smallpeice for the Corporation and by Mr. Lowell Mickelwait for the Boeing Airplane Company.

* * *

Heron LN-SUR of Braathens S.A.F.E., previously reported overdue on a flight from Trondheim to Oslo, was located in the mountains east of To'ga in eastern Norway on November 8. It is reported that ten of the 12 people on board had survived.

* * *

S.N.C.A.S.E. say that talks with seven countries interested in the Caravelle are going well and that the first export contracts are expected within the next six months. The Caravelle's export price is now $1,800,000 (£640,000).

* * *

Substantial orders for Marconi type S232 crystal-controlled all-weather surveillance radar have been placed for Melsbroek airport in Be'gium, Jan Smuts Airport, South Africa, and the airports of London, Gatwick and Elmdon. The R.A.E. at Farnborough and Bedford and the A. and A.E.E. at Boscombe Down will also be similarly supplied.

B.O.A.C. and Qantas are by-passing Djakarta as a result of the withdrawal of facilities by Indonesian workers.

* * *

Captain T. J. Gunn, D.F.C., A.F.C., Croix de Guerre, has been appointed chief pilot of Morton and Olley Air Services, Ltd.

* * *

C.A.B. expects to be able to reduce the subsidies paid to U.S. airlines next year by eight per cent. The present subsidy is £17,200,000.

* * *

First of Swissair's four DC-7Cs was delivered to Zurich on November 12. The 4,160 miles from New York were flown at an average speed of 372 m.p.h.

* * *

The B.E.A. experimental helicopter service between Birmingham, Leicester and Nottingham has been cancelled. Although the service has not been popular the primary reason for its demise was stated to be the petrol shortage.

* * *

I.A.T.A. announce that scheduled airlines flying between Europe and South America will seek government approval for the inauguration of new low-fare tourist services over the South Atlantic on March 1 next year.

* * *

Flight of October 19 recorded the aid that PanAm will give to the Afghan Aryana airline. On November 1 Aeroflot also signed an agreement with the Afghans for commercial co-operation and reciprocal services.

* * *

Seven more Convair 440 Metropolitans have been ordered; four by REAL S.A. Transportes Aereos of Brazil and one each by Ansett Airways of Australia, the Khrumaki Airways of Finland and the Italian Air Force. Orders now total 125.

Personally speaking

—a series of contributions on questions of the hour by leading international aviation personalities.

BEVERLEY S. SHENSTONE

Chief Engineer of British European Airways makes this contribution on . . .

Keeping an airline airborne

If aeroplanes were perfect and couldn't go wrong, airline chief engineers would not be necessary. Reality is not like that. BEA's 100-odd aircraft are kept flying by hard work on the part of the engineers, and sometimes even the best planning and the hardest work cannot avoid the unforeseeable that lurks in any mechanical contrivance.

The facts are roughly these : there are over 3,000 men and women working in BEA's engineering base, and at outstations from Stornoway to Istanbul, involved in planning and working toward safe, sure and punctual air services for the public. In terms of money it costs BEA about £4,000,000 a year to keep these 100 aircraft flying. That is a lot of money and it can only be reduced by concentrated development over many years toward better aircraft and improved techniques.

That leads to pioneering and BEA has invited headaches by introducing an entirely new kind of engine—the Rolls-Royce Dart in the Vickers-Armstrongs Viscount. It has no military history and is still the only propeller-turbine in service. But it is very satisfactory, and although we still have some piston engines in service, I shall be glad when I have to deal with nothing but turbines—the Dart now, later the Tyne, and whatever comes after.

AVIATION BP SERVICE

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Making someone *VERY* happy

With the approach of Christmas, comes the annual problem of suitable gifts for the occasion—suitable both for the recipient and for our own pockets.

One of the arts of 'giving gracefully' is to pay a subtle compliment to the good taste of the recipient by making sure that what is given is the best of its kind. So often, cigarettes turn out to be the right gift for many of our friends and relatives, and here it is doubly important to give something above the 'average' standard. Something that shows you have been thoughtful in your choice wins extra appreciation.

When it comes to cigarettes, one name immediately comes to mind as standing for the best—STATE EXPRESS. For well over half a century, in every part of the world, State Express 555 have been recognised for finest quality and it has become a tradition that State Express 555 and Christmas go together.

The complete range of State Express cigarettes available for Christmas Gifts is an impressive one and the prices are not high. Imagine the delight when parcels are opened on Christmas morning to reveal a handsome pack of 555! Undoubtedly, Christmas is the time for 'everything of the best' and nothing fits the occasion better than State Express.

TANKARDS IN REAL ENGLISH PEWTER

You can see these wonderful value tankards in all the good tobacconists' windows now. They are made in Sheffield in the traditional hammered finish with a glass base, and each contains a round airtight tin of 50 State Express 555. An excellent gift for any male and highly appropriate to the festive season! The 1-pint size costs 39/6, and the ½-pint tankard 30/-.

..... *Express your Greetings with State Express 555*

One needs colour to do justice to this delightful greetings packing. There are two sizes, one containing 50 State Express 555, and the other 100. Each bears a beautifully coloured picture of a traditional Christmas scene of the England of former years.

50 ... 10/5

100 ... 20/10

THE 'DICKENS' JUG

In beautifully ornamented pottery, with characters from Dickens modelled in relief. Colourful and decorative and containing an airtight tin of 50 State Express 555 cigarettes—29/6.

AN IMPRESSIVE CABINET FOR 32/-

A really worthwhile present. This simple but elegant cabinet contains 150 State Express 555 cigarettes—truly inviting. It is finished with a gold design on the familiar primrose colour and costs 32/-.

WHERE TO GET STATE EXPRESS

These delightful presentation packings are stocked by all good tobacconists and stores. Why not ask to see the range of State Express gifts—amongst them you will find something to suit everyone? If you experience any difficulty please write to: The House of State Express, 210, Piccadilly, London, W.1.

GIVE THE BEST FOR CHRISTMAS

BY APPOINTMENT TO HER MAJESTY THE QUEEN STATE EXPRESS CIGARETTE MANUFACTURERS ARDATH TOBACCO CO. LTD.

STATE EXPRESS 555

THE BEST CIGARETTES IN THE WORLD

Champion sailplane in this year's American nationals at Grand Prairie, Texas, the "Jennie-Mae" was piloted by Lyle Maxey of the Southern California Soaring Association.

CLUB AND GLIDING NEWS

RECENTLY entertained at Barton by the Lancashire Aero Club were the Woodford Old Associates, a group of early members of the club whose activities date back to the pioneering days of aviation. During the proceedings a Press invitation to the "Blackpool Flying Carnival in July and August of 1910" was presented to the club. This event had been organized by the Lancashire club, whose president at that time was the Earl of Lonsdale. The club claims that "this, coupled with the fact that the club was known in 1906, seems to establish the fact that it is the oldest club in the country." The new clubhouse at Barton Aerodrome is expected to be opened soon. Radio is being fitted to club aircraft, and it is hoped to acquire a Link trainer.

AT the third annual dinner and dance of the Surrey Flying Club, held in Croydon on November 2, the Harris Trophy for the best flying performance during the past year was presented to Don Probyn, for his achievement in obtaining a Commercial Pilot's Licence within six months of beginning *ab initio* flying training, and for his impressive record of European cross-country flights logged during that period.

Other awards made at the dinner comprised the Thurston Trophy for the best performance in P.P.L. tests, to C. S. Lee; and the Charles Grece Trophy to Stuart Price, one of the club's honorary instructors. This latter trophy, intended to promote safety in flying, had been awarded to the pilot "most successful in extricating himself from a difficult situation not of his own making." Price had made a successful emergency landing downwind at Kenley after the engine of his Tiger Moth had failed at 1,200ft. Mr. C. A. Nepean Bishop, chairman of the club, disclosed that a close runner-up for the Harris Trophy was Miss Ann Briggs, the 1954 winner of this award.

In the interval between the dinner and the dance, an excellent colour film of the club's flight to France for this year's Flers Rally was shown. This film had been made by club members Ken Smith and John Strubbe. Surrey's dinner, film and dance together formed a most enjoyable occasion—and on the largest scale yet, with over 200 members and guests present.

WHEN a club defines the hours it has flown as "productive" and "non-productive" it can be safely assumed that a fairly healthy total has been amassed. This year 3,400 productive hours have already been flown by the 200 active flying members of the Herts and Essex Aero Club at Stapleford Tawney, a total that compares very closely with the other nearest-to-London club at Elstree. An aspect of the Herts and Essex club that will appeal to many private pilots is the range and availability of the aircraft owned by the club. The instructional mainstays are three Austers and three Tiger Moths, but two Hornet Moths are available for cross-countries and a Proctor and a Gemini are available for conversions and advanced training. Touring flying—the ideal of many clubmen—is both possible and encouraged; the second recently acquired Hornet Moth is becoming a familiar visitor on the continent.

Until the advent of the Suez crisis, the Proctor and the Gemini were both used on army co-operation sorties; an activity that has been restricted by the emergency.

The fine clubhouse, ideal for promoting the social side of the club's activities, offers the members many advantages and it is not surprising to find that there are twelve private owner members at Stapleford Tawney. There may soon be more—the construction of a large new hangar on the aerodrome will doubtless be greeted with approval by owners with a housing problem.

Two lesser-known types: the Luton Minor (top) recently re-built by Arthur Ord-Hume, and now Elstree-based; and the recently acquired Wicko G.M.1 of the Southport Aero Club, seen starting a seawards take-off run on the Southport beach airstrip.

YOUTHFUL chairman of the Pioneer Flying Group, Roger Bailey, Jr., is now planning the formation of a constructional club to be known as the Pioneer Ultra-light Flying Group. Prospective members interested in helping to build a Druine Turbulent or similar design are invited to contact him at 10 Woodnook Road, Streatham, London, S.W.16 (Streatham 8615). Tiger Moth flying at 35s per hour is available to members (new members are welcome) of the existing Pioneer Group.

SCOTTISH Aero Club's "September Competition," postponed this year until October because of bad weather, was won by Miss Mackintosh and Miss Saddler. Other events in October, during which month 177 hours were flown, included the showing of the first of the winter evening film programmes and the gaining of P.P.Ls by two scholarship cadets.

FORTHCOMING EVENTS

Nov. 20. R.Ae.S.: Section Lecture: "C. of A. Flight Testing," by D. P. Davies.
Nov. 21. Kronfeld Club: Czechoslovak Films.
Nov. 22. R.Ae.S.: Twelfth British Commonwealth and Empire Lecture: "Aeronautical Development in Australia and its Potential Value to the British Commonwealth," by L. P. Coombes, D.F.C., F.I.A.S., F.R.Ae.S.
Nov. 23. R.Ae.S.: Graduates and Students Section: "Effects of Kinetic Heating on Aircraft Structures," by A. W. Kitchenside.
Nov. 26-27. I.A.S.-C.A.I.: Joint Meeting. Toronto.
Nov. 27. Photogrammetric Society: "Problems and Progress in Air Photography," by G. C. Brook.
Nov. 28. Kronfeld Club: "Test Flying," by A. W. Bedford.
Nov. 30. R.Ae.S.: Graduates and Students Section: Annual Dance.
Dec. 1. British Interplanetary Society: "Use of Probe Rockets," by C. A. Cross, M.A.
Dec. 3-8. Association Pour L'Encouragement a la Recherche Aeronautique: Exhibition of Rockets, Guided Missiles, and their Equipment, Paris.

R.Ae.S. Branch Fixtures (to December 12).

Nov. 19, *Halton*, Film Show. Nov. 21, *Bristol*, Junior Members' Papers Competition; *Christchurch*, "Aeroplane Noise: A Challenge," by Prof. E. J. Richards; *Coventry*, "Some Influences of Equipment and Systems on Aircraft Design," by C. F. Joy; *Reading*, "Interplanetary Flight," by J. Humphries: *Weybridge*, "New Machining Techniques in the Aircraft Industry," by L. G. Burnard and T. A. Waite. Nov. 26, *Henlow*, "Meteorology: Clear Air Turbulence," by Dr. R. S. Scorer. Nov. 27, *Boscombe Down*, "Aeroplane Noise: A Challenge," by Prof. E. J. Richards. Dec. 5, *Bristol*, "Prospects and Problems in British Aviation," by P. G. Masefield; *Luton*, "Trends in Aircraft Electrical Installations," by H. Zeffert. Dec. 12, *Leicester*, Annual General Meeting and Film Show.

SERVICE AVIATION

Royal Air Force and Fleet Air Arm News

Awards for Bravery

THE Air Force Cross has been awarded to F/L. C. M. Graham for safely landing the Hastings which lost a door and became difficult to control over mountainous country in south-east Turkey last July. The reduced effectiveness of the elevator, after the door fouled the tailplane, forced the pilot to land on the 2,000ft runway at Maltaya at a speed of 145 kt. Another member of the crew, F/O. A. Bassett, R.A.A.F., receives the Queen's Commendation for Valuable Service in the Air. Passengers at the time included Gen. Sir Gerald Templer, the C.I.G.S.

The Queen's Commendation for Valuable Service in the Air is also awarded to F/L. P. J. Lagesen for completing a sortie when his aircraft was partially out of control; and the Queen's Commendation for Brave Conduct has been given to S/A.C. J. M. Stevenson, L/A.C. R. Norden and L/A.C. H. Pennington for their courage when fighting armed intruders at a radio station at Shaibah, Iraq.

Rescue Inside Antarctic Circle

THE two Whirlwind helicopters carried by H.M.S. *Protector* recently rescued two men of a sledging party from Roux Island. They also picked up equipment, specimens and nine husky dogs in five flights between ship and camp. Two other members of the expedition had previously walked across the pack ice to obtain assistance. This is the first time since 1843 that the Antarctic Circle has been crossed in the Weddell and Bellinghausen Sea area in November.

Note in this picture of the bombing-up of a Canberra in Cyprus, during the recent Egyptian operations, the special Anglo-French wing and fuselage markings. In the original photograph the Valettas, distantly glimpsed, are seen to be similarly marked.

F.A.A. On Parade

FOR the first time Naval Air Stations of Home Air Command provided ratings for three ceremonies in London last weekend. Taking part in the Lord Mayor's Show was a detachment of 54 from Culdrose; 26 ratings from Lee-on-Solent provided the guard at the Festival of Remembrance at the Albert Hall, and 23 ratings formed the Cenotaph guard last Sunday.

S.B.A.C. Donation

IN recognition of the part played by the R.A.F. at this year's display at Farnborough, the S.B.A.C. has presented £2,000 to the R.A.F. Benevolent Fund.

Mobility Exercise

CANBERRAS of No. 6 (Bomber) Sqn., R.A.A.F., are now carrying out their annual mobility exercises at Darwin and are also making a series of flights to Singapore. The first pair landed at Changi a week ago. Next year a bomber wing will be based in Malaya at Butterworth, a new airfield being built by No. 2 Airfield Construction Squadron, R.A.A.F.

Director of Medical Services

AFTER serving as Director of Medical Services to the R.N.Z.A.F. between 1948 and 1950, A.V-M. P. B. Lee Potter has been appointed Director of Medical Services to the R.A.F. The appointment will take effect early next year and will carry the acting rank of air marshal.

Sycamore Presentation

TO commemorate the part played by a Bristol Sycamore of No. 275 Search and Rescue Squadron in rescuing the crew of a wrecked merchant ship last February, a silver-plated model of the helicopter was presented last week to the squadron's commanding officer, S/L. B. A. Primavesi, by Mr. F. W. Higginson on behalf of Bristol Aircraft, Ltd. No. 275 Sqn. is the only all-Sycamore squadron in the United Kingdom.

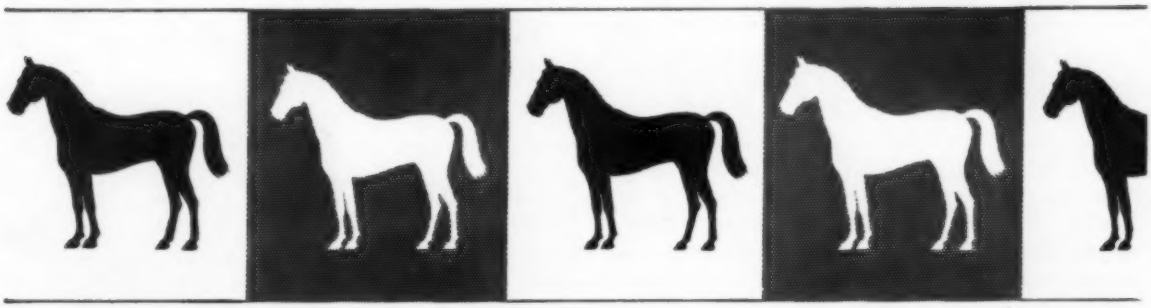
It was one of the squadron's Sycamores detached at Leuchars which went to the assistance of s.s. *Dovrefjell*, wrecked on the Pentland Skerries in heavy seas. In four runs, F/L. Kirk Smith, the pilot, was able to take eleven members of the ship's crew to safety. Two Naval Whirlwinds played a major part in the rescue.

Freedom of Palmerston North

THE R.N.Z.A.F. Station Ohakea and the nearby Linton Military Camp were granted the freedom of Palmerston North during ceremonies held recently.

More markings in Cyprus—this time those of Hawker Hunter F.5s of No. 34 Squadron together with No. 1 Sqn. machines.

How much do 4.3 horses weigh?



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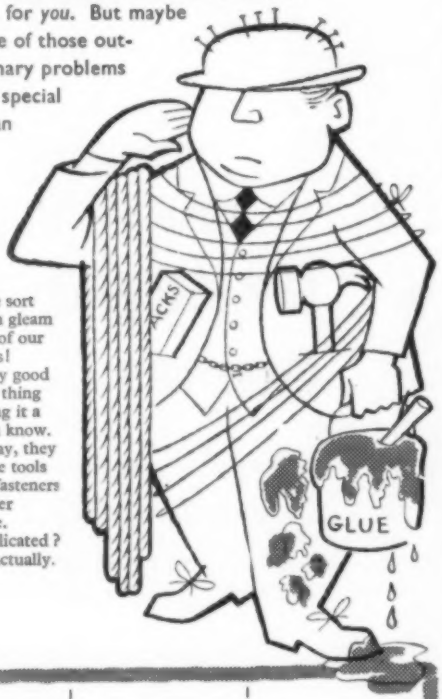
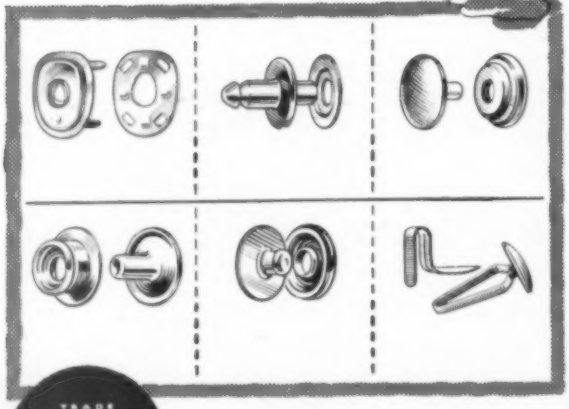


. . . . that's the sort of job to put a gleam into the eyes of our design experts! They're pretty good at this sort of thing . . . been doing it a long time you know. Oh, by the way, they also evolve the tools for fixing the fasteners to the whatever it is you make. Sounds complicated? Very simple actually.



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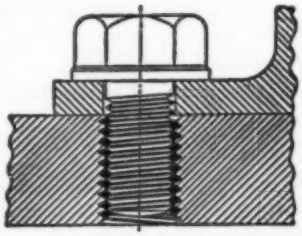

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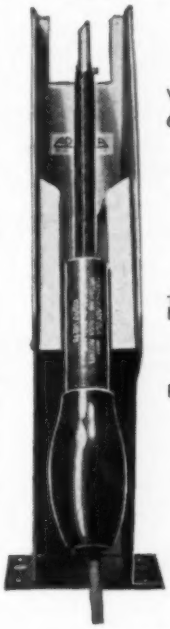

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PUBLIC ANNOUNCEMENTS

AIR TRANSPORT ADVISORY COMMITTEE

THE AIR TRANSPORT ADVISORY COUNCIL give notice that they have received the undermentioned applications to operate scheduled air services:—

APPLICATION No. 982. From Transair Ltd., of Croydon Airport, Croydon, Surrey, for a Normal Scheduled Service, initially Seasonal, with Dakota aircraft for the carriage of passengers, supplementary freight and mail between London (Croydon and/or Gatwick) and Minorca at a frequency of one service weekly increasing further according to traffic demand during the season from April to October inclusive each year, for a period of 10 years, commencing from date of approval.

APPLICATION No. 984. From Derby Aviation Ltd., of Derby Airport, Burnaston, Near Derby, for a Normal Scheduled Service with Dakotas, Marathon and D.H.89 aircraft for the carriage of passengers and supplementary freight between Derby and Birmingham and Rotterdam at a frequency of from three to seven services weekly for a period of seven years commencing from date of approval.

THESE applications will be considered by the Council under the Terms of Reference issued to them by the Minister of Civil Aviation on 30th July, 1952. Any representations or objections with regard to these applications must be made in writing stating the reasons and must reach the Council within 14 days of the date of this advertisement, addressed to the Secretary, Air Transport Advisory Council, 3 Dean's Yard, London, S.W.1, from whom further details of the applications may be obtained. When an objection is made to an application by another air transport company on the grounds that they are applying to operate the route or part of route in question, their application, if not already submitted to the Council, should reach them within the period allowed for the making of representations or objections. [5926

PUBLIC APPOINTMENTS

APPLICATIONS ARE INVITED FOR PENSIONABLE POSTS AS EXAMINERS in the PATENT OFFICE

TO undertake the official scientific, technical and legal work in connexion with Patent applications. There is a small number of similar posts in the Ministry of Supply.

AGE at least 21 and under 35 years on 1st January, 1956, with extension for regular Forces' service.

CANDIDATES must have 1st or 2nd class Honours in Physics, Chemistry, Mechanical or Electrical Engineering or in Mathematics, or an equivalent qualification, (e.g. A.M.I.M.E., A.M.I.C.E., A.M.I.E.E., A.R.I.C.), but for a limited number of vacancies candidates with 1st or 2nd class honours degrees in other subjects—scientific or otherwise—will be considered. Candidates over 28 and under 35 on 1st January, 1956, will, exceptionally, be admitted without these requirements if they have specially relevant experience.

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APPLICATION form and further particulars from Civil Service Commission, Scientific Branch, 30, Old Burlington Street, London, W.1, quoting S 128/56 and stating date of birth.

SELECTION Board sits at intervals, as required.

EARLY application advised and in any case not later than 31st December, 1956. 5929

GROUND Engineer (Aircraft Maintenance) required by the Government of the Northern Region of Nigeria on contract for one tour of 12-24 months in first instance. Salary scale (including inducement addition) £810 rising to £1,716 a year. Gratuity at rate of £100/150 a year. Clothing allowance £45. Free passage for officer and wife. Assistance towards cost of children's passages and grant up to £288 a year. Liberal leave on full salary. Candidates, aged 28 to 40, should have had considerable experience of aircraft maintenance and possess aircraft maintenance engineer's licence endorsed for categories "A" and "C" on Auster Auto-Car airframes and Cirrus 3 engines. Write to the Crown Agents, 4 Millbank, London, S.W.1. State age, name in block letters, full qualifications and experience and quote M2A/41986/FE. [5920

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PUBLIC APPOINTMENTS

SENIOR Scientific Officers: Scientific Officers. The Civil Service Commissioners invite applications for pensionable appointments covering a wide range of scientific research and development in most of the major fields of fundamental and applied science. In biological subjects the number of vacancies is small: individual vacancies exist in the Natural History Museum for candidates who have special knowledge of, or who are interested in, malacology, helminthology, acarology, mammalian taxonomy, taxonomic botany (monocotyledons), X-ray crystallography.

CANDIDATES must have obtained a university degree with first or second class honours in an appropriate scientific subject (including engineering) or in Mathematics, or an equivalent qualification; or possess high professional attainments. Candidates for Senior Scientific Officer posts must in addition have had at least three years' post-graduate or other approved experience.

AGE Limits: Senior Scientific Officers, between 26 and 31, but specially suitable candidates under 26 may be admitted; for Scientific Officers, between 21 and 28 during 1956 (up to 31 for permanent members of the Experimental Officer class). Salary (London) Senior Scientific Officers: (men) £1,135-£1,345; (Women) £1,026-£1,240. Scientific Officers: (men) £605-£1,055; (women) £605-£962. Women's scales being improved under equal pay scheme. Somewhat lower rates in the provinces.

FURTHER particulars from Civil Service Commission, Scientific Branch, 30, Old Burlington Street, London, W.1, quoting No. S.53/56 for Senior Scientific Officers and S.52/56 for Scientific Officers.

INTERVIEW Board sits at intervals, as required.

EARLY application advised and in any case not later than 31st December, 1956. [5930

SENIOR Scientific Officer required by Ministry of Supply at Boscombe Down, Nr. Amesbury, Wilts., for Helicopter Research and Development. 1st or 2nd class honours degree or equivalent in Engineering, Mathematics, or Physics. At least three years post-graduate research experience required. Previous experience on Helicopters desirable but not essential. Minimum age 26. Salary within range £1,075-£1,265 (Superannuable). Houses become available from time to time for married officers. Forms from M.N.L.S., Technical and Scientific Register (K), 26, King Street, London, S.W.1, quoting C293/6A. [5928

METEOROLOGICAL Office, Scientific Officers. The Civil Service Commissioners invite applications for permanent posts. Early application is advised. The duties include research in atmospheric physics, covering the study of cloud structure, synoptic and dynamical meteorology, large and small scale diffusion and turbulence, climatology, and development of instruments. There is a limited number of posts for forecasting work at the more important centres. Successful candidates will be given a course in meteorology before being assigned to a research or forecasting establishment for further training and experience. In some instances candidates with national service obligations can be commissioned in the R.A.F. for forecasting duties at R.A.F. stations. Further information may be obtained from the Director, Meteorological Office, (M.O.10), Air Ministry, Kingsway, London, W.C.2.

CANDIDATES must be between 21 and 28 during 1956 (up to 31 for permanent members of the Experimental Officer class). They must have a First or Second Class Honours degree preferably in physics or mathematics. Salaries (London rates) £605-£1,055. Women's scales lower but being improved under equal pay scheme. Somewhat lower rates in provinces. Opportunities for promotion to Senior Scientific Officer (£1,135-£1,345), and higher posts.

PARTICULARS from Civil Service Commission, Scientific Branch, 30, Old Burlington Street, London, W.1, quoting No. S52/56. (Met.).

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3. Senior Design Draughtsman for general design work connected with gas and oil fired furnaces and auxiliary equipment. H.N.C. or equivalent qualification.
4. Senior Design Draughtsman with good knowledge of pipework layout and detail for steam, water, gas and air services to buildings and plant. H.N.C. or equivalent qualification.
5. Senior Design Draughtsman with good general knowledge of layout and design of mechanical plant, e.g. rolling mills and ancillaries, drawbenches, special purpose plant, materials handling equipment, etc. Work is widely varied and interesting. H.N.C. qualification preferred, but sound design experience essential.
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Quoting Reference ADO/W/5.

SITUATIONS VACANT

SENIOR Stressmen required with 5 or 6 years' experience. Apply in the first instance to the Chief Designer, Gloster Aircraft Co., Ltd., Gloucester, stating age, qualifications, experience and salary required. [5881

FOLLAND AIRCRAFT LIMITED invite applications from Senior and Intermediate Draughtsmen for their expanding programme of work. Applications, stating age, experience and salary required, to the Personnel Manager, Folland Aircraft, Ltd., Hamble, Hants. [5893

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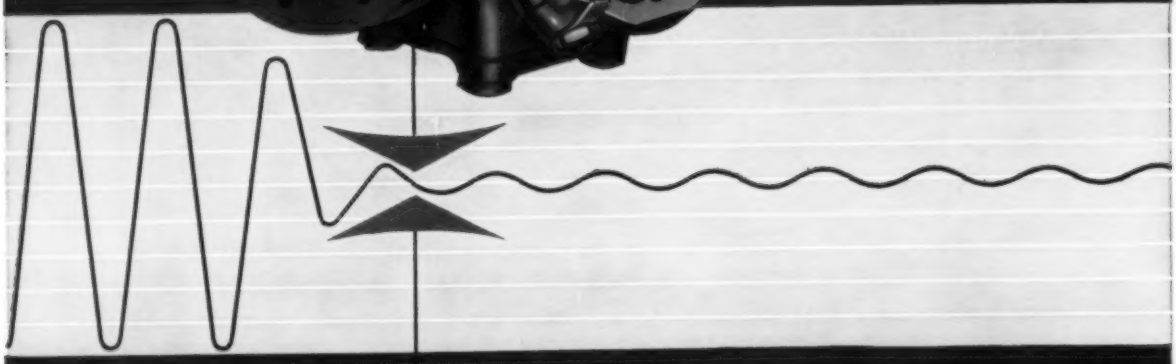

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